INGENIERÍA ECONÓMICA

Cuarta edición

SOLUTIONS MANUAL

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SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 1

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, and 49

1.1 Time value of money means that there is a certain worth in having money and the worth changes as a function of time.

1.4 Nearest, tastiest, quickest, classiest, most scenic, etc

1.7 Minimum attractive rate of return is the lowest rate of return (interest rate) that companies or individuals consider to be high enough to induce them to invest their money.

1.10 Rate of increase = [(29 – 22)/22]*100 = 31.8%

1.13 Profit = 8 million*0.28 = $2,240,000

1.16 (a) Equivalent future amount = 10,000 + 10,000(0.08)
= 10,000(1 + 0.08)
= $10,800

(b) Equivalent past amount: P + 0.08P = 10,000
1.08P = 10,000
P = $9259.26

1.19 80,000 + 80,000(i) = 100,000
i = 25%

1.22 Simple: 1,000,000 = 500,000 + 500,000(i)(5)
i = 20% per year simple

Compound: $1,000,000 = 500,000(1 + i)^5$
$(1 + i)^5 = 2.0000$
$(1 + i) = (2.0000)^{0.2}$
i = 14.87%

1.25 Plan 1: Interest paid each year = 400,000(0.10)
= $40,000

Total paid = 40,000(3) + 400,000
= $520,000

Plan 2: Total due after 3 years = $400,000(1 + 0.10)^3$
= $532,400

Difference paid = 532,400 – 520,000
= $12,400

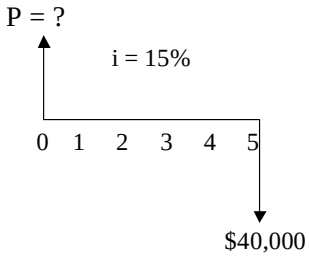
1.28 (a) FV(i%,n,A,P) finds the future value, F
(b) IRR(first_cell:last_cell) finds the compound interest rate, i
(c) PMT(i%,n,P,F) finds the equal periodic payment, A
(d) PV(i%,n,A,F) finds the present value, P.

1.31 For built-in Excel functions, a parameter that does not apply can be left blank when it is not an interior one. For example, if there is no F involved when using the PMT function to solve a particular problem, it can be left blank because it is an end function. When the function involved is an interior one (like P in the PMT function), a comma must be put in its position.

1.34 Highest to lowest rate of return is as follows: Credit card, bank loan to new business, corporate bond, government bond, interest on checking account

1.37 End of period convention means that the cash flows are assumed to have occurred at the end of the period in which they took place.

1.40 The cash flow diagram is:



1.43 4 = 72/i
i = 18% per year

1.46 2P = P + P(0.05)(n)
n = 20
Answer is (d)

1.49 Answer is (c)

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CHAPTER 2

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58, 61, 64, 67, 70, 73, 76, 79, and 82

2.1 1. (F/P,8%25) = 6.8485; 2. (P/A,3%,8) = 7.0197; 3. (P/G,9%,20) = 61.7770;
4. (F/A,15%,18) = 75.8364; 5. (A/P,30%,15) = 0.30598

2.4 P = 600,000(P/F,12%,4)
= 600,000(0.6355)
= $381,300

2.7 P = 75(P/F,18%,2)
= 75(0.7182)
= $53.865 million

2.10 P = 162,000(P/F,12%,6)
= 162,000(0.5066)
= $82,069

2.13 P = 1.25(0.10)(P/F,8%,2) + 0.5(0.10)(P/F,8%,5)
= 0.125(0.8573) + 0.05(0.6806)
= $141,193

2.16 A = 1.8(A/P,12%,6)
= 1.8(0.24323)
= $437,814

2.19 P = 75,000(P/A,15%,5)
= 75,000(3.3522)
= $251,415

2.22 P = 2000(P/A,8%,35)
= 2000(11.6546)
= $23,309

2.25 (a) 1. Interpolate between n = 32 and n = 34:
1/2 = x/0.0014
x = 0.0007
(P/F,18%,33) = 0.0050 – 0.0007
= 0.0043

2. Interpolate between n = 50 and n = 55:

$4/5 = x/0.0654$

$x = 0.05232$

$(A/G,12\%,54) = 8.1597 + 0.05232$

$= 8.2120$

(b) 1. $(P/F,18\%,33) = 1/(1+0.18)^{33}$

$= 0.0042$

2. $(A/G,12\%,54) = \{(1/0.12) - 54/[(1+0.12)^{54} - 1\}$

$= 8.2143$

2.28 (a) G = \$5 million (b) CF_6 = \$6030 million (c) n = 12

2.31 (a) $CF_3 = 280,000 - 2(50,000)$

= \$180,000

(b) $A = 280,000 - 50,000(A/G,12\%,5)$

$= 280,000 - 50,000(1.7746)$

= \$191,270

2.34 $A = 14,000 + 1500(A/G,12\%,4)$

$= 14,000 + 1500(1.3589)$

= \$16,038

2.37 $50 = 6(P/A,12\%,6) + G(P/G,12\%,6)$

$50 = 6(4.1114) + G(8.9302)$

G = \$2,836,622

2.40 For g = i, $P = 60,000(0.1)[15/(1 + 0.04)]$

= \$86,538

2.43 First find P and then convert to F:

$P = 2000\{1 - [(1+0.10)^7/(1+0.15)^7\}]\}/(0.15 - 0.10)$

$= 2000(5.3481)$

= \$10,696

$F = 10,696(F/P,15\%,7)$

$= 10,696(2.6600)$

= \$28,452

2.46 g = i: $P = 1000[20/(1 + 0.10)]$

$= 1000[18.1818]$

= \$18,182

2.49 Simple: Total interest = (0.12)(15) = 180%

Compound: $1.8 = (1 + i)^{15}$

i = 4.0%

2.52 1,000,000 = 600,000(F/P,i,5)
(F/P,i,5) = 1.6667
i = 10.8% (Spreadsheet)

2.55 85,000 = 30,000(P/A,i,5) + 8,000(P/G,i,5)
i = 38.9% (Spreadsheet)

2.58 2,000,000 = 100,000(P/A,5%,n)
(P/A,5%,n) = 20.000
From 5% table, n is between 40 and 45 years; by spreadsheet, 42 > n > 41
Therefore, n = 41 years

2.61 10A = A(F/A,10%,n)
(F/A,10%,n) = 10.000

From 10% table, n is between 7 and 8 years; therefore, n = 8 years

2.64 P = 61,000(P/F,6%,4)
= 61,000(0.7921)
= $48,318
Answer is (c)

2.67 109.355 = 7(P/A,i,25)
(P/A,i,25) = 15.6221
From tables, i = 4%
Answer is (a)

2.70 P = 8000(P/A,10%,10) + 500(P/G,10%,10)
= 8000(6.1446) + 500(22.8913)
= $60,602.45
Answer is (a)

2.73 F = 100,000(F/A,18%,5)
= 100,000(7.1542)
= $715,420
Answer is (c)

2.76 A = 100,000(A/P,12%,5)
= 100,000(0.27741)
= $27,741
Answer is (b)

2.79 F = 10,000(F/P,12%,5) + 10,000(F/P,12%,3) + 10,000
= 10,000(1.7623) + 10,000(1.4049) + 10,000

= $41,672
Answer is (c)

2.82 60,000 = 15,000(P/A,18%,n)
(P/A,18%,n) = 4.000
n is between 7 and 8
Answer is (b)

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CHAPTER 3

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58, and 61

3.1 P = 100,000(260)(P/A,10%,8)(P/F,10%,2)
= 26,000,000(5.3349)(0.8264)
= $114.628 million

3.4 P = 100,000(P/A,15%,3) + 200,000(P/A,15%,2)(P/F,15%,3)
= 100,000(2.2832) + 200,000(1.6257)(0.6575)
= $442,100

3.7 A = [0.701(5.4)(P/A,20%,2) + 0.701(6.1)(P/A,20%,2)((P/F,20%,2)](A/P,20%,4)
= [3.7854(1.5278) + 4.2761(1.5278)(0.6944)](0.38629)
= $3.986 billion

3.10 A = 8000(A/P,10%,10) + 600
= 8000(0.16275) + 600
= $1902

3.13 A = 15,000(F/A,8%,9)(A/F,8%,10)
= 15,000(12.4876)(0.06903)
= $12,930

3.16 A = [20,000(F/A,8%,11) + 8000(F/A,8%,7)](A/F,8%,10)
= [20,000(16.6455) + 8000(8.9228)]{0.06903)
= $27,908

3.19 100,000 = A(F/A,7%,5)(F/P,7%,10)
100,000 = A(5.7507)(1.9672)
A = $8839.56

3.22 Amt year 5 = 1000(F/A,12%,4)(F/P,12%,2) + 2000(P/A,12%,7)(P/F,12%,1)
= 1000(4.7793)(1.2544) + 2000(4.5638)(0.8929)
= $14,145

3.25 Move unknown deposits to year –1, amortize using A/P, and set equal to $10,000:
x(F/A,10%,2)(F/P,10%,19)(A/P,10%,15) = 10,000
x(2.1000)(6.1159)(0.13147) = 10,000

x = $5922.34

3.28 Find P at t = 0 and then convert to A:
P = $22,994

A = 22,994(A/P,12%,8)
= 22,994(0.20130)
= $4628.69

3.31 Amt year 3 = 900(F/A,16%,4) + 3000(P/A,16%,2) – 1500(P/F,16%,3)
+ 500(P/A,16%,2)(P/F,16%,3)
= 900(5.0665) + 3000(1.6052) – 1500(0.6407)
+ 500(1.6052)(0.6407)
= $8928.63

3.34 P = [4,100,000(P/A,6%,22) – 50,000(P/G,6%,22)](P/F,6%,3)
+ 4,100,000(P/A,6%,3)
= [4,100,000(12.0416) – 50,000(98.9412](0.8396)
+ 4,100,000(2.6730)
= $48,257,271

3.37 First find P at t = 0 and then convert to A:
P = $82,993

A = 82,993(A/P,12%,5)
= 82,993(0.27741)
= $23,023

3.40 40,000 = x(P/A,10%,2) + (x + 2000)(P/A,10%,3)(P/F,10%,2)
40,000 = x(1.7355) + (x + 2000)(2.4869)(0.8264)
3.79067x = 35,889.65
x = $9467.89 (size of first two payments)

3.43 Find P in year –1 and then find A in years 0-5:
P_g (in yr 2) = (5)(4000){[1 - $(1 + 0.08)^{18}$/$(1 + 0.10)^{18}$](0.10 - 0.08)}
= $281,280
P in yr –1 = 281,280(P/F,10%,3) + 20,000(P/A,10%,3)
= $261,064

A = 261,064(A/P,10%,6)
= $59,943

3.46 Find P in year –1 and then move to year 0:
P (yr –1) = 15,000{[1 – $(1 + 0.10)^5$/$(1 + 0.16)^5$](0.16 – 0.10)}
= $58,304

P = 58,304(F/P,16%,1)
= $67,632

3.49 P = 5000 + 1000(P/A,12%,4) + [1000(P/A,12%,7) – 100(P/G,12%,7)](P/F,12%,4)
= $10,198

3.52 P = 2000 + 1800(P/A,15%,5) – 200(P/G,15%,5)
= $6878.94

3.55 P = 7 + 7(P/A,4%,25)
= $116.3547 million
Answer is (c)

3.58 Balance = 10,000(F/P,10%,2) – 3000(F/A,10%,2)
= 10,000(1.21) – 3000(2.10)
= $5800
Answer is (b)

3.61 100,000 = A(F/A,10%,4)(F/P,10%,1)
100,000 = A(4.6410)(1.10)
A = $19,588
Answer is (a)

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CHAPTER 4

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58, 61, 64, 67, 70, and 73

4.1 (a) monthly (b) quarterly (c) semiannually

4.4 (a) 1 (b) 4 (c) 12

4.7 (a) 5% (b) 20%

4.10 $i = (1 + 0.04)^4 - 1$
$= 16.99\%$

4.13 $0.1881 = (1 + 0.18/m)^m - 1$; Solve for m by trial and get m = 2

4.16 (a) i/week = 0.068/26
= 0.262%
(b) effective

4.19 From 2% table at n=12, F/P = 1.2682

4.22 F = 2.7(F/P,3%,60)
= $15.91 billion

4.25 P = 1.3(P/A,1%,28)(P/F,1%,2)
= $30,988,577

4.28 F = 50(20)(F/P,1.5%,9)
= $1.1434 billion

4.31 i/wk = 0.25%
P = 2.99(P/A,0.25%,40)
= $113.68

4.34 P = (14.99 – 6.99)(P/A,1%,24)
= 8(21.2434)
= $169.95

4.37 2,000,000 = A(P/A,3%,8) + 50,000(P/G,3%,8)
A = $117,665

4.40 Move deposits to end of compounding periods and then find F:
F = 1800(F/A,3%,30)
= $85,636

4.43 Move monthly costs to end of quarter and then find F:
Monthly costs = 495(6)(2) = $5940
End of quarter costs = 5940(3) = $17,820
F = 17,820(F/A,1.5%,4)
= $72,900

4.46 $0.127 = e^r - 1$
$r/yr = 11.96\%$
$r/quarter = 2.99\%$

4.49 $i = e^{0.02} - 1 = 2.02\%$ per month
$A = 50(A/P,2.02\%,36)$
$= 50\{[0.0202(1 + 0.0202)^{36}]/[(1 + 0.0202)^{36} - 1]\}$
= $1,968,000

4.52 Set up F/P equation in months:
$3P = P(1 + i)^{60}$
$3.000 = (1 + i)^{60}$
$i = 1.85\%$ per month (effective)

4.55 First move cash flow in years 0-4 to year 4 at i = 12%:
F = $36,543
Now move cash flow to year 5 at i = 20%:

F = 36,543(F/P,20%,1) + 9000
= $52,852

4.58 Answer is (d)

4.61 Answer is (d)

4.64 $i/semi = e^{0.02} - 1 = 0.0202 = 2.02\%$
Answer is (b)

4.67 P = 7 + 7(P/A,4%,25)
= $116.3547 million
Answer is (c)

4.70 PP>CP; must use i over PP (1 year); therefore, n = 7
Answer is (a)

4.73 Deposit in year 1 = $1250/(1 + 0.05)^3$

= $1079.80

Answer is (d)

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CHAPTER 5

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58, 61, and 64

5.1 A service alternative is one that has only costs (no revenues).

5.4 (a) Total possible = $2^5 = 32$

(b) Because of restrictions, cannot have any combinations of 3,4, or 5. Only 12 are acceptable: DN, 1, 2, 3, 4, 5, 1&3, 1&4, 1&5, 2&3, 2&4, and 2&5.

5.7 Capitalized cost represents the present worth of service for an infinite time. Real world examples that might be analyzed using CC would be Yellowstone National Park, Golden Gate Bridge, Hoover Dam, etc.

5.10 Bottled water: Cost/mo = -(2)(0.40)(30) = $24.00
PW = -24.00(P/A,0.5%,12)
= $-278.85

Municipal water: Cost/mo = -5(30)(2.10)/1000 = $0.315
PW = -0.315(P/A,0.5%,12)
= $-3.66

5.13 PW_{JX} = -205,000 – 29,000(P/A,10%,4) – 203,000(P/F,10%,2)
+ 2000(P/F,10%,4)
= $-463,320

PW_{KZ} = -235,000 – 27,000(P/A,10%,4) + 20,000(P/F,10%,4)
= $-306,927

Select material KZ

5.16 i/year = $(1 + 0.03)^2 - 1 = 6.09\%$
PW_A = -1,000,000 - 1,000,000(P/A,6.09%,5)
= -1,000,000 - 1,000,000(4.2021) (by equation)
= $-5,202,100

PW_B = -600,000 – 600,000(P/A,3%,11)
= $-6,151,560

PW_C = -1,500,000 – 500,000(P/F,3%,4) – 1,500,000(P/F,3%,6)
- 500,000(P/F,3%,10)
= $-3,572,550

Select plan C

5.19 $FW_{purchase}$ = -150,000(F/P,15%,6) + 12,000(F/A,15%,6) + 65,000
= $-176,921

FW_{lease} = -30,000(F/A,15%,6)(F/P,15%,1)
= $-302,003

Purchase the clamshell

5.22 CC = -400,000 – 400,000(A/F,6%,2)/0.06
=$-3,636,267

5.25 CC = -250,000,000 – 800,000/0.08 – [950,000(A/F,8%,10)]/0.08
- 75,000(A/F,8%,5)/0.08
= $-251,979,538

5.28 Find AW of each plan, then take difference, and divide by i.
AW_A = -50,000(A/F,10%,5)
= $-8190

AW_B = -100,000(A/F,10%,10)
= $-6275

CC of difference = (8190 - 6275)/0.10
= $19,150

5.31 CC = 100,000 + 100,000/0.08
= $1,350,000

5.34 No-return payback refers to the time required to recover an investment at i = 0%.

5.37 0 = -22,000 + (3500 – 2000)(P/A,4%,n)
(P/A,4%,n) = 14.6667

n is between 22 and 23 *quarters* or 5.75 years

5.40 $-250,000 – 500n + 250,000(1 + 0.02)^n = 100,000$

Try n = 18: 98,062 < 100,000
Try n = 19: 104,703 > 100,000

n is 18.3 months or 1.6 years.

5.43 LCC = – 2.6(P/F,6%,1) – 2.0(P/F,6%,2) – 7.5(P/F,6%,3) – 10.0(P/F,6%,4)
-6.3(P/F,6%,5) – 1.36(P/A,6%,15)(P/F,6%,5) -3.0(P/F,6%,10)
- 3.7(P/F,6%,18)
= $-36,000,921

5.46 I = 10,000(0.06)/4 = $150 every 3 months

5.49 Bond interest rate and market interest rate are the same.
Therefore, PW = face value = $50,000.

5.52 I = (V)(0.07)/2
201,000,000 = I(P/A,4%,60) + V(P/F,4%,60)

Try V = 226,000,000: 201,000,000 > 200,444,485
Try V = 227,000,000: 201,000,000 < 201,331,408

By interpolation, V = $226,626,340

5.55 PW = 50,000 + 10,000(P/A,10%,15) + [20,000/0.10](P/F,10%,15)
= $173,941
Answer is (c)

5.58 PW_X = -66,000 –10,000(P/A,10%,6) + 10,000(P/F,10%,6)
= $-103,908
Answer is (c)

5.61 CC = -10,000(A/P,10%,5)/0.10
= $-26,380
Answer is (b)

5.64 Answer is (a)

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CHAPTER 6

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, and 31

6.1 The estimate obtained from the three-year AW would *not* be valid, because the AW calculated over one life cycle is valid only for the *entire cycle*, not part of the cycle. Here the asset would be used for only a part of its three-year life cycle.

6.4 $AW_{centrifuge} = -250,000(A/P,10\%,6) - 31,000 + 40,000(A/F,10,6)$
$= \$-83,218$

$AW_{belt} = -170,000(A/P,10\%,4) - 35,000 - 26,000(P/F,10\%,2)(A/P,10\%,4)$
$+ 10,000(A/F,10\%,4)$
$= \$-93,549$

Select centrifuge.

6.7 $AW_X = -85,000(A/P,12\%,3) - 30,000 + 40,000(A/F,12\%,3)$
$= \$-53,536$

$AW_Y = -97,000(A/P,12\%,3) - 27,000 + 48,000(A/F,12\%,3)$
$= \$-53,161$

Select robot Y by a small margin.

6.10 $AW_C = -40,000(A/P,15\%,3) - 10,000 + 12,000(A/F,15\%,3)$
$= \$-24,063$

$AW_D = -65,000(A/P,15\%,6) - 12,000 + 25,000(A/F,15\%,6)$
$= \$-26,320$

Select machine C.

6.13 $AW_{land} = -110,000(A/P,12\%,3) - 95,000 + 15,000(A/F,12\%,3)$
$= \$-136,353$

$AW_{incin} = -800,000(A/P,12\%,6) - 60,000 + 250,000(A/F,12\%,6)$
$= \$-223,777$

$AW_{contract} = \$-190,000$

Use land application.

6.16 $AW_{100} = 100,000(A/P,10\%,100)$
$= \$10,001$

$AW_{\infty} = 100{,}000(0.10)$
$= \$10{,}000$

Difference is \$1.

6.19 $AW = -100{,}000(0.08) - 50{,}000(A/F,8\%,5)$
$= -100{,}000(0.08) - 50{,}000(0.17046)$
$= \$-16{,}523$

6.22 Find P in year –1, move to year 9, and then multiply by i. Amounts are in \$1000.

$P_{-1} = [100(P/A,12\%,7) - 10(P/G,12\%,7)](F/P,12\%,10)$
$= \$1055.78$

$A = 1055.78(0.12)$
$= \$126.69$

6.25 Find PW in year 0 and then multiply by i.

$PW_0 = 50{,}000 + 10{,}000(P/A,10\%,15) + (20{,}000/0.10)(P/F,10\%,15)$
$= \$173{,}941$

6.28 Note: i = *effective* 10% per year.

$A = [100{,}000(F/P,10\%,5) - 10{,}000(F/A,10\%,6)](0.10)$
$= \$8389$

6.31 $AW = -800{,}000(0.10) - 10{,}000$
$= \$-90{,}000$

Answer is (c)

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CHAPTER 7

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7.1 A rate of return of –100% means that the entire investment is lost.

7.4 Monthly pmt = 100,000(A/P,0.5%,360)
= 100,000(0.00600)
= $600

Balloon pmt = 100,000(F/P,0.5%,60) – 600(F/A,0.5%,60)
= 100,000(1.3489) – 600(69.7700)
= $93,028

7.7 0 = -30,000 + (27,000 – 18,000)(P/A,i%,5) + 4000(P/F,i%,5)
Solve by trial and error or Excel
i = 17.9 % (Excel)

7.10 0 = -10 – 4(P/A,i%,3) - 3(P/A,i%,3)(P/F,i%,3) + 2(P/F,i%,1) + 3(P/F,i%,2)
+ 9(P/A,i%,4)(P/F,i%,2)
Solve by trial and error or Excel
i = 14.6% (Excel)

7.13 (a) 0 = -41,000,000 + 55,000(60)(P/A,i%,30)
Solve by trial and error or Excel
i = 7.0% per year (Excel)

(b) 0 = -41,000,000 + [55,000(60) + 12,000(90)](P/A,i%,30)
0 = -41,000,000 + (4,380,000)(P/A,i%,30)
Solve by trial and error or Excel
i = 10.1% per year (Excel)

7.16 0 = -110,000 + 4800(P/A,i%,60)
(P/A,i%,60) = 22.9167

Use tables or Excel
i = 3.93% per month (Excel)

7.19 0 = -950,000 + [450,000(P/A,i%,5) + 50,000(P/G,i%,5)])(P/F,i%,10)

Solve by trial and error or Excel

i = 8.45% per year (Excel)

7.22 In a conventional cash flow series, there is only one sign change in the *net cash flow*. A nonconventional series has more than one sign change.

7.25 Tabulate net cash flows and cumulative cash flows.

Quarter	Expenses	Revenue	Net Cash Flow	Cumulative
0	-20	0	-20	-20
1	-20	5	-15	-35
2	-10	10	0	-35
3	-10	25	15	-20
4	-10	26	16	-4
5	-10	20	10	+6
6	-15	17	2	+8
7	-12	15	3	+11
8	-15	2	-13	-2

(a) From net cash flow column, there are two possible i* values

(b) In cumulative cash flow column, sign starts negative but it changes twice. Therefore, Norstrom's criterion is not satisfied. Thus, there may be up to two i* values. However, in this case, since the cumulative cash flow is negative, there is no positive rate of return value.

7.28 The net cash flow and cumulative cash flow are shown below.

Year	Expenses, $	Savings, $	Net Cash Flow, $	Cumulative, $
0	-33,000	0	-33,000	-33,000
1	-15,000	18,000	+3,000	-30,000
2	-40,000	38,000	-2000	-32,000
3	-20,000	55,000	+35,000	+3000
4	-13,000	12,000	-1000	+2000

(a) There are four sign changes in net cash flow, so, there are four possible i* values.

7.28 (cont) (b) Cumulative cash flow starts negative and changes only once. Therefore, there is only one positive, real solution.

$$0 = -33{,}000 + 3000(P/F,i\%,1) - 2000(P/F,i\%,2) + 35{,}000(P/F,i\%,3) - 1000(P/F,i\%,4)$$

Solve by trial and error or Excel
i = 2.1% per year (Excel)

7.31 Tabulate net cash flow and cumulative cash flow values.

Year	Cash Flow, $	Cumulative, $
1	-5000	-5,000
2	-5000	-10,000
3	-5000	-15,000
4	-5000	-20,000
5	-5000	-25,000
6	-5000	-30,000
7	+9000	-21,000
8	-5000	-26,000
9	-5000	-31,000
10	-5000 + 50,000	+14,000

(a) There are three changes in sign in the net cash flow series, so there are three possible ROR values. However, according to Norstrom's criterion regarding cumulative cash flow, there is only one ROR value.

(b) Move all cash flows to year 10.
0 = -5000(F/A,i,10) + 14,000(F/P,i,3) + 50,000

Solve for i by trial and error or Excel

i = 6.3% (Excel)

(c) If Equation [7.6] is applied, all F values are negative except the last one. Therefore, i' is used in all equations. The composite ROR (i') is the same as the internal ROR value (i*) of 6.3% per year.

7.34 Apply net reinvestment procedure because reinvestment rate, c, is not equal to i* rate of 44.1% per year (from problem 7.29):

$F_0 = -5000$ $F_0 < 0$; use i'

$F_1 = -5000(1 + i') + 4000$

$= -5000 – 5000i' + 4000$

$= -1000 – 5000i'$ $F_1 < 0$; use i'

$F_2 = (-1000 – 5000i')(1 + i')$

$= -1000 – 5000i' –1000i' – 5000i'^2$

$= -1000 – 6000i' – 5000i'^2$ $F_2 < 0$; use i'

$F_3 = (-1000 – 6000i' – 5000i'^2)(1 + i')$

$= -1000 – 6000i' – 5000i'^2 –1000i' – 6000'i^2 – 5000i'^3$

$= -1000 – 7000i' – 11{,}000i'^2 – 5000i'^3$ $F_3 < 0$; use i'

$F_4 = (-1000 – 7000i' – 11{,}000i'^2 – 5000i'^3)(1 + i') + 20{,}000$

$= 19{,}000 – 8000i' – 18{,}000i'^2 – 16{,}000i'^3 - 5{,}000i'^4$ $F_4 > 0$; use c

$F_5 = (19{,}000 – 8000i' – 18{,}000i'^2 – 16{,}000i'^3 - 5{,}000i'^4)(1.15) – 15{,}000$

$= 6850 – 9200i' – 20{,}700i'^2 – 18{,}400i'^3 - 5{,}750i'^4$

Set $F_5 = 0$ and solve for i' by trial and error or spreadsheet.

i' = 35.7% per year

7.37 (a) i = 5,000,000(0.06)/4 = $75,000 per quarter

After brokerage fees, the City got $4,500,000. However, *before* brokerage fees, the ROR equation from the City's standpoint is:

0 = 4,600,000 – 75,000(P/A,i%,120) - 5,000,000(P/F,i%,120)

Solve for i by trial and error or Excel

i = 1.65% per quarter (Excel)

(b) Nominal i per year = 1.65(4)
= 6.6% per year

Effective i per year = $(1 + 0.066/4)^4 – 1$
= 6.77% per year

7.40 i = 5000(0.10)/2
= $250 per six months

0 = -5000 + 250(P/A,i%,8) + 5,500(P/F,i%,8)

Solve for i by trial and error or Excel

i = 6.0% per six months (Excel)

7.43 Answer is (c)

7.46 0 = -60,000 + 10,000(P/A,i,10)
(P/A,i,10) = 6.0000

From tables, i is between 10% and 11%
Answer is (a)

7.49 0 = -100,000 + (10,000/i)(P/F,i,4)
Solve for i by trial and error or Excel

i = 9.99%% per year (Excel)
Answer is (a)

7.52 250 = (10,000)(b)/2
b = 5% per year payable semiannually
Answer is (c)

7.55 Since the bond was purchased for its face value, the interest rate received by the purchaser is the bond interest rate of 10% per year payable quarterly. Answers (a) and (b) are correct. Therefore, the best answer is (c).

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 8

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, and 43

8.1 (a) The rate of return on the increment has to be larger than 18%.
(b) The rate of return on the increment has to be smaller than 10%.

8.4 The rate of return on the increment of investment is less than 0.

8.7 (a) Incremental investment analysis is *not* required. Alternative X should be selected because the rate of return on the increment is known to be lower than 20%
(b) Incremental investment analysis is *not* required because only Alt Y has ROR greater than the MARR
(c) Incremental investment analysis is *not* required. Neither alternative should be selected because neither one has a ROR greater than the MARR.
(d) The ROR on the increment is less than 26%, but an incremental investment analysis *is* required to determine if the rate of return on the increment equals or exceeds the MARR of 20%
(e) Incremental investment analysis is *not* required because it is known that the ROR on the increment is greater than 22%.

8.10

Year	Machine A	Machine B	B – A
0	-15,000	-25,000	-10,000
1	-1,600	-400	+1200
2	-1600	-400	+1200
3	-15,000 –1600 + 3000	-400	+13,200
4	-1600	-400	+1200
5	-1600	-400	+1200
6	+3000 –1600	+6000 – 400	+4200

8.13 (a) Find rate of return on incremental cash flow.

$$0 = -3000 - 200(P/A,i,3) + 4700(P/F,i,3)$$

$i = 10.4\%$ (Excel)

(b) Incremental ROR is less than MARR; select Ford.

8.16 $0 = -10{,}000 + 1200(P/A,i,4) + 12{,}000(P/F,i,2) + 1000(P/F,i,4)$

Solve for i by trial and error or Excel

i = 30.3% (Excel)
Select machine B.

8.19 Find P to yield exactly 50% and the take difference.
0 = -P + 400,000(P/F,i,1) + 600,000(P/F,i,2) + 850,000(P/F,i,3)
P = 400,000(0.6667) + 600,000(0.4444) + 850,000(0.2963)
= $785,175

Difference = 900,000 – 785,175
= $114,825

8.22 Find ROR for incremental cash flow over LCM of 4 years

0 = -50,000(A/P,i,4) + 5000 + (40,000 – 5000)(P/F, i,2)(A/P, i,4) + 2000(A/F,i,4)

Solve for i by trial and error or Excel
i = 6.1% (Excel)

i < MARR; select semiautomatic machine

8.25 Find ROR on increment of investment.
0 = -500,000(A/P,i,10) + 60,000
i = 3.5% < MARR
Select design 1A

8.28 (a) A vs DN: 0 = -30,000(A/P,i,8) + 4000 + 1000(A/F,i,8)
Solve for i by trial and error or Excel
i = 2.1% (Excel)
Method A is *not* acceptable

B vs DN: 0 = - 36,000(A/P,i,8) + 5000 + 2000(A/F,i,8)
Solve for i by trial and error or Excel
i = 3.4% (Excel)
Method B is *not* acceptable

C vs DN: 0 = - 41,000(A/P,i,8) + 8000 + 500(A/F,i,8)
Solve for i by trial and error or Excel
i = 11.3% (Excel)
Method C *is* acceptable

8.28 (cont)
D vs DN: 0 = - 53,000(A/P,i,8) + 10,500 - 2000(A/F,i,8)
Solve for i by trial and error or Excel
i = 11.1% (Excel)
Method D *is* acceptable

(b) A vs DN: 0 = -30,000(A/P,i,8) + 4000 + 1000(A/F,i,8)
Solve for i by trial and error or Excel
i = 2.1% (Excel)
Eliminate A

B vs DN: 0 = - 36,000(A/P,i,8) + 5000 + 2000(A/F,i,8)
Solve for i by trial and error or Excel
i = 3.4% (Excel)
Eliminate B

C vs DN: 0 = - 41,000(A/P,i,8) + 8000 + 500(A/F,i,8)
Solve for i by trial and error or Excel
i = 11.3% (Excel)
Eliminate DN

C vs D: 0 = - 12,000(A/P,i,8) + 2,500 - 2500(A/F,i,8)
Solve for i by trial and error or Excel
i = 10.4% (Excel)
Eliminate D

Select method C

8.31 (a) Select all projects whose ROR > MARR of 15%. Select A, B, and C

(b) Eliminate alternatives with ROR < MARR; compare others incrementally:
Eliminate D and E
Rank survivors according to increasing first cost: B, C, A

B vs C: i = 800/5000
= 16% > MARR Eliminate B

C vs A: i = 200/5000
= 4% < MARR Eliminate A

Select project C

8.34 (a) Find ROR for each increment of investment:

E vs F: 20,000(0.20) + 10,000(i) = 30,000(0.35)
i = 65%

E vs G: 20,000(0.20) + 30,000(i) = 50,000(0.25)

i = 28.3%

E vs H: 20,000(0.20) + 60,000(i) = 80,000(0.20)
i = 20%

F vs G: 30,000(0.35) + 20,000(i) = 50,000(0.25)
i = 10%

F vs H: 30,000(0.35) + 50,000(i) = 80,000(0.20)
i = 11%

G vs H: 50,000(0.25) + 30,000(i) = 80,000(0.20)
i = 11.7%

(b) Revenue = A = Pi
E: A = 20,000(0.20) = $4000
F: A = 30,000(0.35) = $10,500
G: A = 50,000(0.25) = $12,500
H: A = 80,000(0.20) = $16,000

(c) Conduct incremental analysis using results from part (a):
E vs DN: i = 20% > MARR eliminate DN
E vs F: i = 65% > MARR eliminate E
F vs G: i = 10% < MARR eliminate G
F vs H: i = 11% < MARR eliminate H
Select Alternative F

(d) Conduct incremental analysis using results from part (a).
E vs DN: i = 20% >MARR, eliminate DN
E vs F: i = 65% > MARR, eliminate E
F vs G: i = 10% < MARR, eliminate G
F vs H: i = 11% = MARR, eliminate F

Select alternative H

8.34 (cont)
(e) Conduct incremental analysis using results from part (a).
E vs DN: i = 20% > MARR, eliminate DN
E vs F: i = 65% > MARR, eliminate E
F vs G: i = 10% < MARR, eliminate G
F vs H: i = 11% < MARR, eliminate H

Select F as first alternative; compare remaining alternatives incrementally.

E vs DN: i = 20% > MARR, eliminate DN
E vs G: i = 28.3% > MARR, eliminate E
G vs H: i = 11.7% < MARR, eliminate H

Select alternatives F and G

8.37 Answer is (c)

8.40 Answer is (d)

8.43 Answer is (b)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 9

Solutions included for problems: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 32, 34, 37, 40, and 43

9.1 (a) Public sector projects usually require large initial investments while many private sector investments may be medium to small.

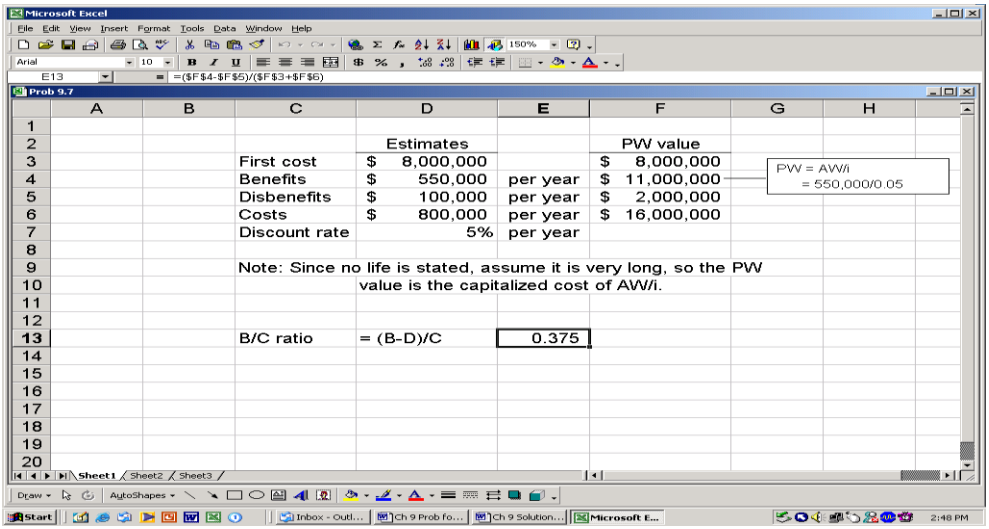
(b) Public sector projects usually have long lives (30-50 years) while private sector projects are usually in the 2-25 year range.

(c) Public sector projects are usually funded from taxes, government bonds, or user fees. Private sector projects are usually funded via stocks, corporate bonds, or bank loans.

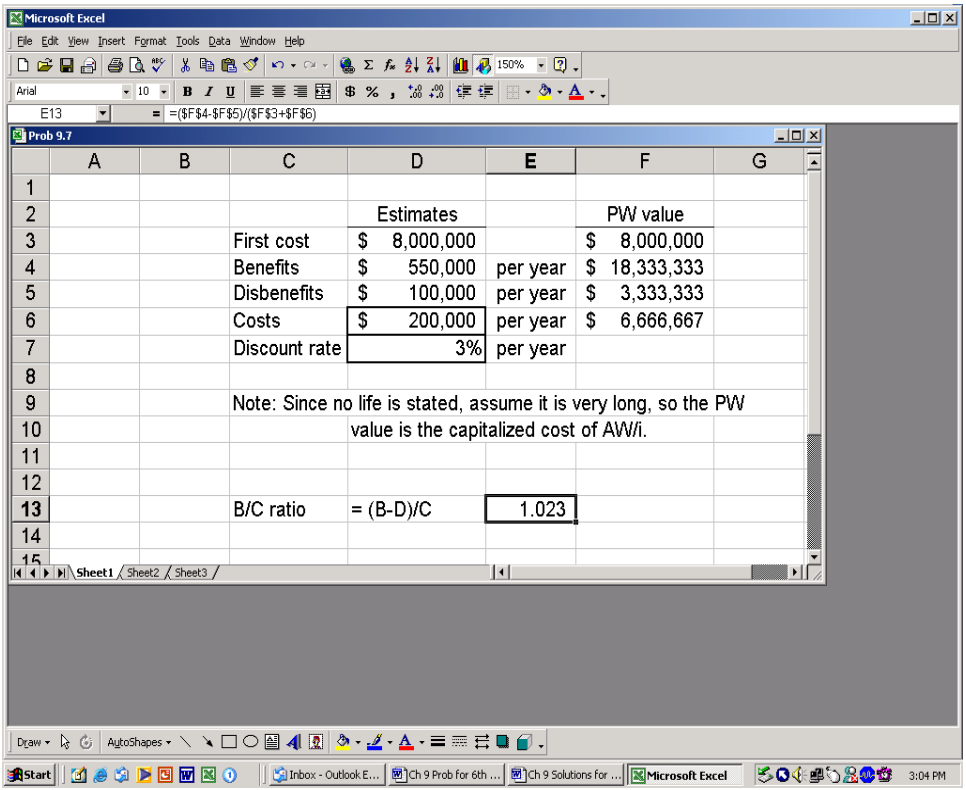
9.4 Some different dimensions are:

1. Contractor is involved in design of highway; contractor is not provided with the final plans before building the highway.
2. Obtaining project financing may be a partial responsibility in conjunction with the government unit.
3. Corporation will probably operate the highway (tolls, maintenance, management) for some years after construction.
4. Corporation will legally own the highway right of way and improvements until contracted time is over and title transfer occurs.
5. Profit (return on investment) will be stated in the contract.

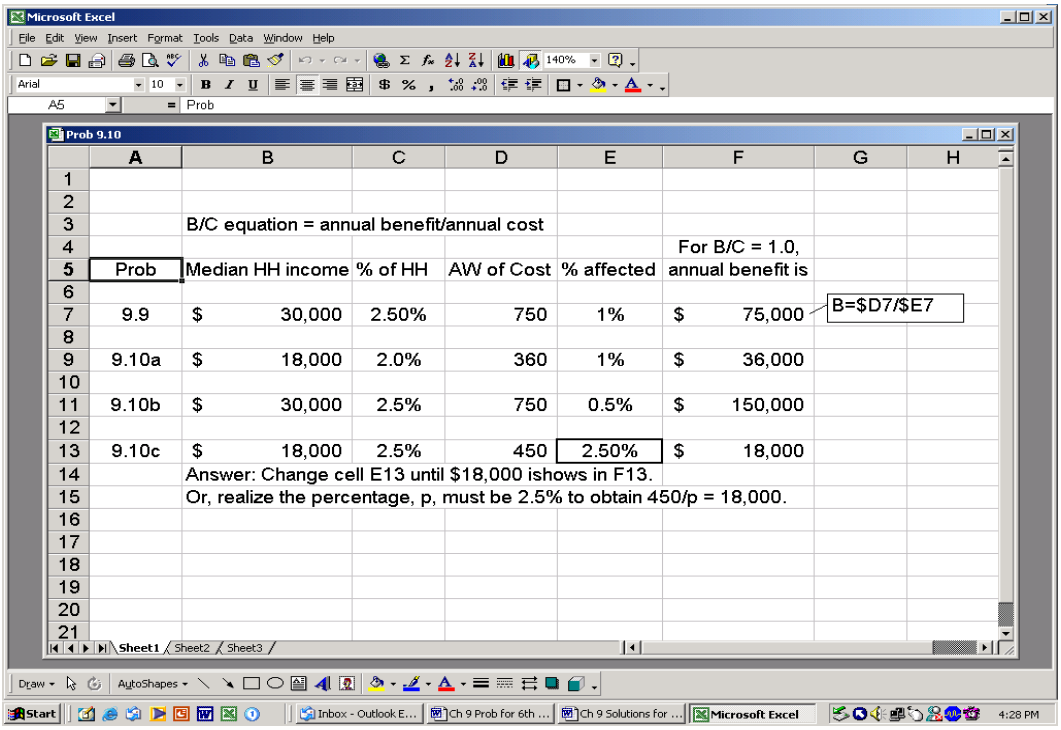
9.7 (a)



(b) Change cell D6 to $200,000 to get B/C = 1.023.



9.10 All parts are solved on the spreadsheet once it is formatted using cell references.



9.13 (a) By-hand solution: First, set up AW value relation of the initial cost, P capitalized a 7%. Then determine P for B/C = 1.3.

$$1.3 = \frac{600{,}000}{P(0.07) + 300{,}000}$$

$$P = [(600{,}000/1.3) - 300{,}000]/0.07 = \$2{,}307{,}692$$

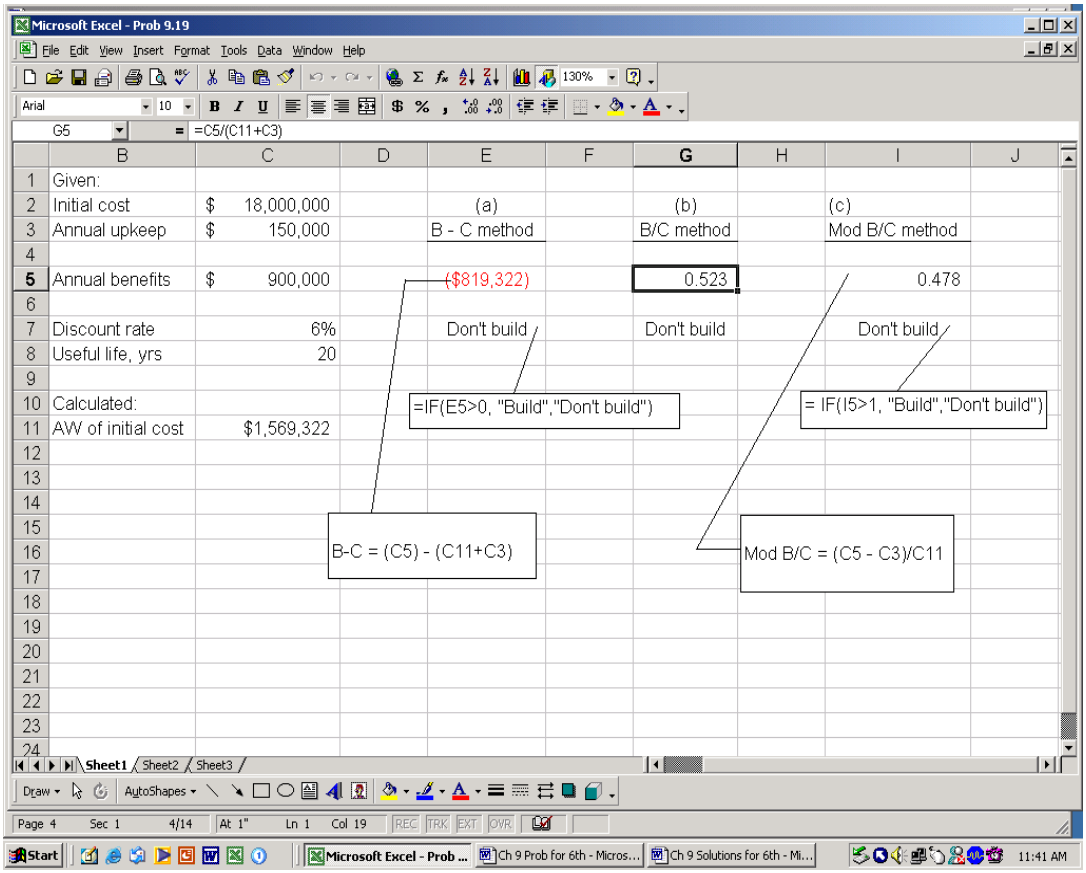
9.16 Convert all estimates to PW values.

PW disbenefits = 45,000(P/A,6%,15) = $437,049

PW M&O Cost = 300,000(P/A,6%,15) = $2,913,660

$$B/C = \frac{3{,}800{,}000 - 437{,}049}{2{,}200{,}000 + 2{,}913{,}660} = 0.66$$

9.19 Calculate the AW of initial cost, then the 3 B/C measures of worth. The roadway should not be built.



9.22 Alternative B has a larger total annual cost; it must be incrementally justified.

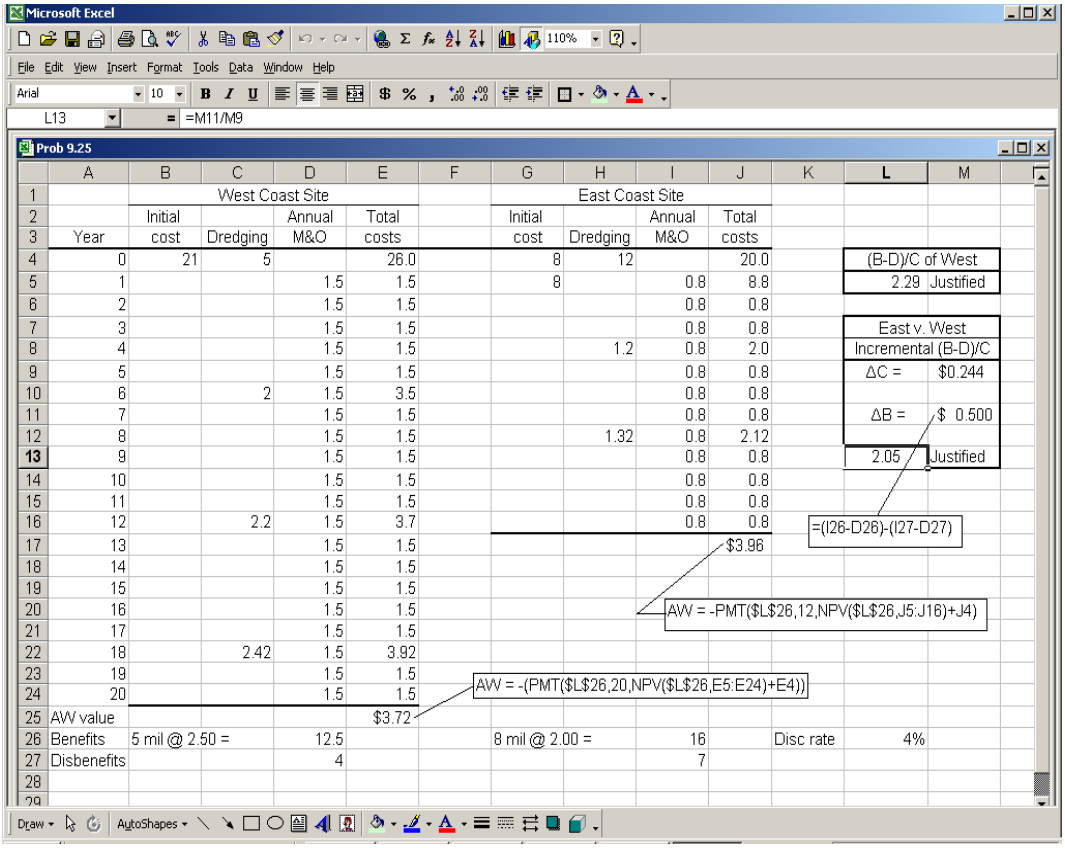
$$\text{Incr cost} = (800{,}000 - 600{,}000) + (70{,}000 - 50{,}000)(P/A,8\%,20)$$
$$= \$396{,}362$$

$$\text{Incr benefit} = (950{,}000 - 250{,}000)(P/F,8\%,6)$$
$$= 441{,}140$$

$$\text{Incr B/C} = 441{,}140/396{,}362 = 1.11$$

Select alternative B

9.25 East coast site has the larger total cost. Select east coast site.



9.28 (b) Location E

B = 500,000 – 30,000 – 50,000 = $420,000
C = 3,000,000 (0.12) = $360,000
Modified B/C = 420,000/360,000 = 1.17

Location E is justified.

Location W
Incr B = $200,000
Incr D = $10,000
Incr C = (7 million – 3 million)(0.12) = $480,000
Incr M&O = (65,000 – 25,000) – 50,000 = $-10,000

Note that M&O is now an incremental cost advantage for W.

$$\text{Modified incr B/C} = \frac{200{,}000 - 10{,}000 + 10{,}000}{480{,}000} = 0.42$$

W is not justified; select location E

9.32 Combine the investment and installation costs, difference in usage fees define benefits. Use the procedure in Section 9.3 to solve. Benefits are the incremental amounts for lowered costs of annual usage for each larger size pipe.

1, 2. Order of incremental analysis: Size	130	150	200	230
Total first cost, $	9,780	11,310	14,580	17,350
3. Annual benefits, $	--	200	600	300

4. Not used since the benefits are defined by usage costs.

5-7. Determine incremental B and C and select at each pairwise comparison of defender vs challenger.

<u>150 vs 130 mm</u>

$\Delta C = (11,310 - 9,780)(A/P,8\%,15)$
$= 1,530(0.11683)$
$= \$178.75$
$\Delta B = 6,000 - 5,800$
$= \$200$
$\Delta B/C = 200/178.75$
$= 1.12 > 1.0$ Eliminate 130 mm size.

<u>200 vs 150 mm</u>

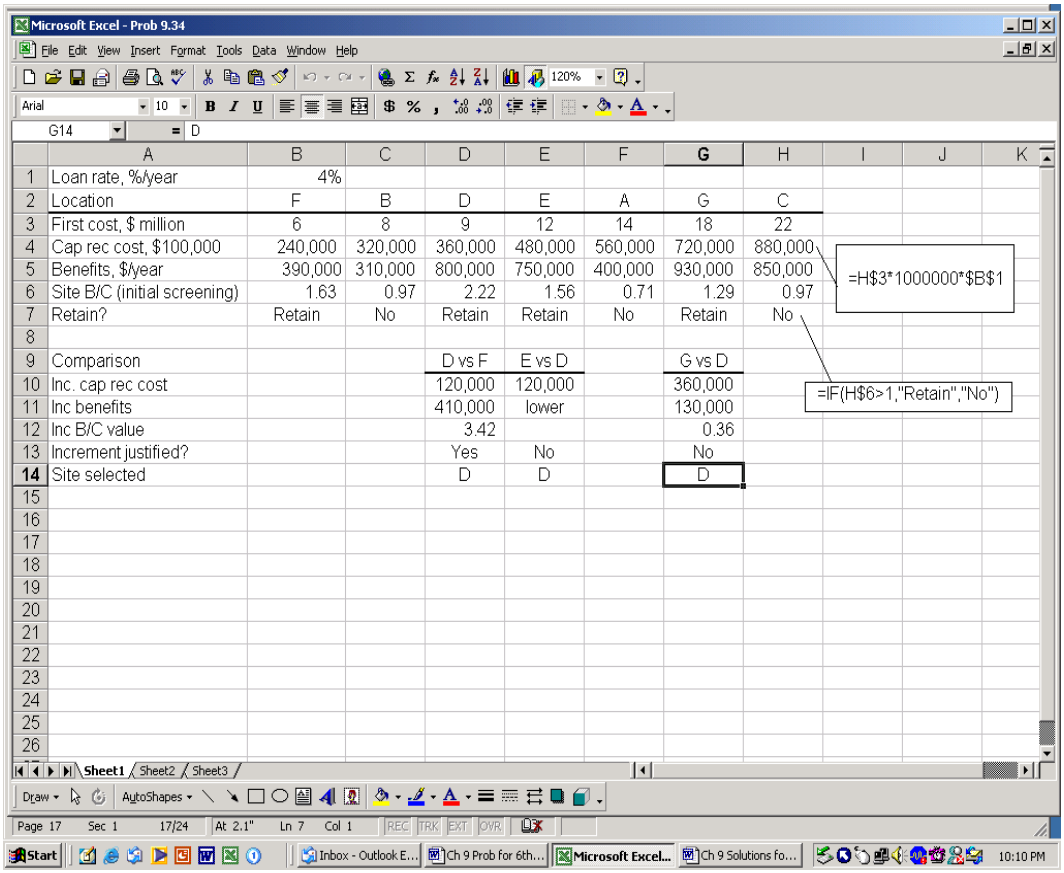
$\Delta C = (14,580 - 11,310)(A/P,8\%,15)$
$= 3270(0.11683)$
$= \$382.03$
$\Delta B = 5800 - 5200$
$= \$600$
$\Delta B/C = 600/382.03$
$= 1.57 > 1.0$ Eliminate 150 mm size.

<u>230 vs 200 mm</u>

$\Delta C = (17,350 - 14,580)(A/P,8\%,15)$
$= 2770(0.11683)$
$= \$323.62$
$\Delta B = 5200 - 4900$
$= \$300$
$\Delta B/C = 0.93 < 1.0$ Eliminate 230 mm size.

Select 200 mm size.

9.34 (a) Site D is the one selected.



	A	B	C	D	E	F	G	H
1	Loan rate, %/year	4%						
2	Location	F	B	D	E	A	G	C
3	First cost, $ million	6	8	9	12	14	18	22
4	Cap rec cost, $100,000	240,000	320,000	360,000	480,000	560,000	720,000	880,000
5	Benefits, $/year	390,000	310,000	800,000	750,000	400,000	930,000	850,000
6	Site B/C (initial screening)	1.63	0.97	2.22	1.56	0.71	1.29	0.97
7	Retain?	Retain	No	Retain	Retain	No	Retain	No
8								
9	Comparison			D vs F	E vs D		G vs D	
10	Inc. cap rec cost			120,000	120,000		360,000	
11	Inc benefits			410,000	lower		130,000	
12	Inc B/C value			3.42			0.36	
13	Increment justified?			Yes	No		No	
14	Site selected			D	D		D	

(b) For independent projects, select the largest three of the four with B/C > 1.0. Those selected are: D, F, and E.

9.37 (a) Find benefits for each alternative and then calculate incremental B/C ratios.

<u>Benefits for P:</u>	$1.1 = B_P/10$	$B_P = 11$
<u>Benefits for Q</u>:	$2.4 = B_Q/40$	$B_Q = 96$
<u>Benefits for R:</u>	$1.4 = B_R/50$	$B_R = 70$
<u>Benefits for S:</u>	$1.5 = B_S/80$	$B_S = 120$

<u>Incremental B/C for Q vs P</u>

$$B/C = \frac{96 - 11}{40 - 10} = 2.83$$

<u>Incremental B/C for R vs P</u>

B/C = 1.48

9.37 (cont) <u>Incremental B/C for S vs P</u>

B/C = 1.56

Incremental B/C for R vs Q
B/C = -2.60
Disregard due to less B for more C.

Incremental B/C for S vs Q
B/C = 0.60

Incremental B/C for S vs R
B/C = 1.67

(b) Select Q

9.40 Answer is (a)

9.43 Answer is (c)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 10

Solutions included for: 2, 5, 8, 11, 12, 14, 16, 20, 23, 24, 27, 29, 32, 35, 38, 41, 44, and 46

10.2 Incremental cash flow analysis is mandatory for the ROR method and B/C method. (See Table 10.2 and Section 10.1 for comments.)

10.5 (a) Hand solution: Choose the AW or PW method at 0.5% for equal lives over 60 months.

Computer solution: Either the PMT function or the PV function can give single-cell solutions for each alternative.

(b) The B/C method was the evaluation method in chapter 9, so rework it using AW.

Hand solution: Find the AW for each cash flow series on a per household per month basis.

$AW_1 = 1.25 – 60(A/P,0.5\%,60)$
$= \$0.09$

$AW_2 = 8.00 - 500(A/P,0.5\%,60)$
$= \$-1.67$
Select program 1

10.8 (a) Bonds are debt financing
(b) Stocks are always equity
(c) Equity
(d) Equity loans are debt financing, like house mortgage loans

10.11 (a) Select 2. It is the alternative investing the maximum available with incremental i* > 9%
(b) Select 3
(c) Select 3
(d) MARR = 10% for alternative 4 is opportunity cost at $400,000 level

10.14 (a) Calculate the two WACC values.

$WACC_1 = 0.6(12\%) + 0.4\,(9\%) = 10.8\%$
$WACC_2 = 0.2(12\%) + 0.8(12.5\%) = 12.4\%$

Use approach 1, with a D-E mix of 40%-60%

(b) Let x_1 and x_2 be the maximum costs of debt capital.

Alternative 1: $10\% = WACC_1 = 0.6(12\%) + 0.4(x_1)$
$x_1 = [10\% - 0.6(12\%)]/0.4$
$= 7\%$
Debt capital cost would have to decrease from 9% to 7%.

Alternative 2: $10\% = WACC_2 = 0.2(12\%) + 0.8(x_2)$
$x_2 = [10\% - 0.2(12\%)]/0.8$
$= 9.5\%$
Debt capital cost would, again, have to decrease; now from 12.5% to 9.5%

10.16 WACC = cost of debt capital + cost of equity capital
$= (0.4)[0.667(8\%) + 0.333(10\%)] + (0.6)[(0.4)(5\%) + (0.6)(9\%)]$
$= 7.907\%$

10.20 Before-taxes: WACC = 0.4(9%) + 0.6(12%) = 10.8% per year

After-tax:

After-tax WACC = (equity)(equity rate) + (debt)(before-tax debt rate)$(1–T_e)$
$= 0.4(9\%) + 0.6(12\%)(1\text{-}0.35)$
$= 8.28\%$ per year

10.23 Equity cost of capital is stated as 6%.
Debt cost of capital benefits from tax savings.

Before-tax bond annual interest = 4 million (0.08) = \$320,000
Annual bond interest NCF = 320,000(1 – 0.4) = \$192,000
Effective quarterly dividend = 192,000/4 = \$48,000

Find quarterly i* using a PW relation.
0 = 4,000,000 - 48,000(P/A,i*,40) - 4,000,000(P/F,i*,40)
i* = 1.2% per quarter = 4.8% per year (nominal)
Debt financing at 4.8% per year is cheaper than equity funds at 6% per year.

(Note: The correct answer is also obtained if the before-tax debt cost of 8% is used to estimate the after-tax debt cost of 8%(1 - 0.4) = 4.8%.)

10.24 (a) <u>Bank loan:</u>
Annual loan payment = 800,000(A/P,8%,8) = \$139,208
Principal payment = 800,000/8 = \$100,000
Annual interest = 139,208 – 100,000 = \$39,208
Tax saving = 39,208(0.40) = \$15,683

Effective interest payment = 39,208 – 15,683 = $23,525
Effective annual payment = 23,525 + 100,000 = $123,525

The AW-based i* relation is:
0 = 800,000(A/P,i*,8) –123,525
i* = 4.95%

Bond issue:

Annual bond interest = 800,000(0.06) = $48,000
Tax saving = 48,000(0.40) = $19,200
Effective bond interest = 48,000 – 19,200 = $28,800

The AW-based i* relation is:
0 = 800,000(A/P,i*,10) - 28,800 - 800,000(A/F,i*,10)
i* = 3.6% (RATE or IRR function)

Bond financing is cheaper.

(b) Bonds cost 6% per year, which is less than the 8% loan. The answer is the same before-taxes.

10.27 Debt capital cost: 9.5% for $6 million

Equity -- common stock: 100,000(32) = $3.2 million or 32% of total capital

$R_e = 1.10/ 32 + 0.02 = 5.44\%$

Equity -- retained earnings: cost is 5.44% for this 8% of total capital.

WACC = 0.6(9.5%) + 0.32(5.44%) + 0.08(5.44%) = 7.88%

10.29 Determine the effective annual interest rate i_a for each plan.

Plan 1: i_a for debt $= (1 + 0.00583)^{12} - 1 = 7.225\%$
i_a for equity $= (1 + 0.03)^2 - 1 = 6.09\%$
$WACC_A = 0.5(7.225\%) + 0.5(6.09\%) = 6.66\%$
Plan 2: i_a for 100% equity = $WACC_B = (1 + 0.03)^2 - 1 = 6.09\%$
Plan 3: i_a for 100% debt = $WACC_C = (1 + 0.00583)^{12} - 1 = 7.225\%$

Plan 2: 100% equity has the lowest before-tax WACC.

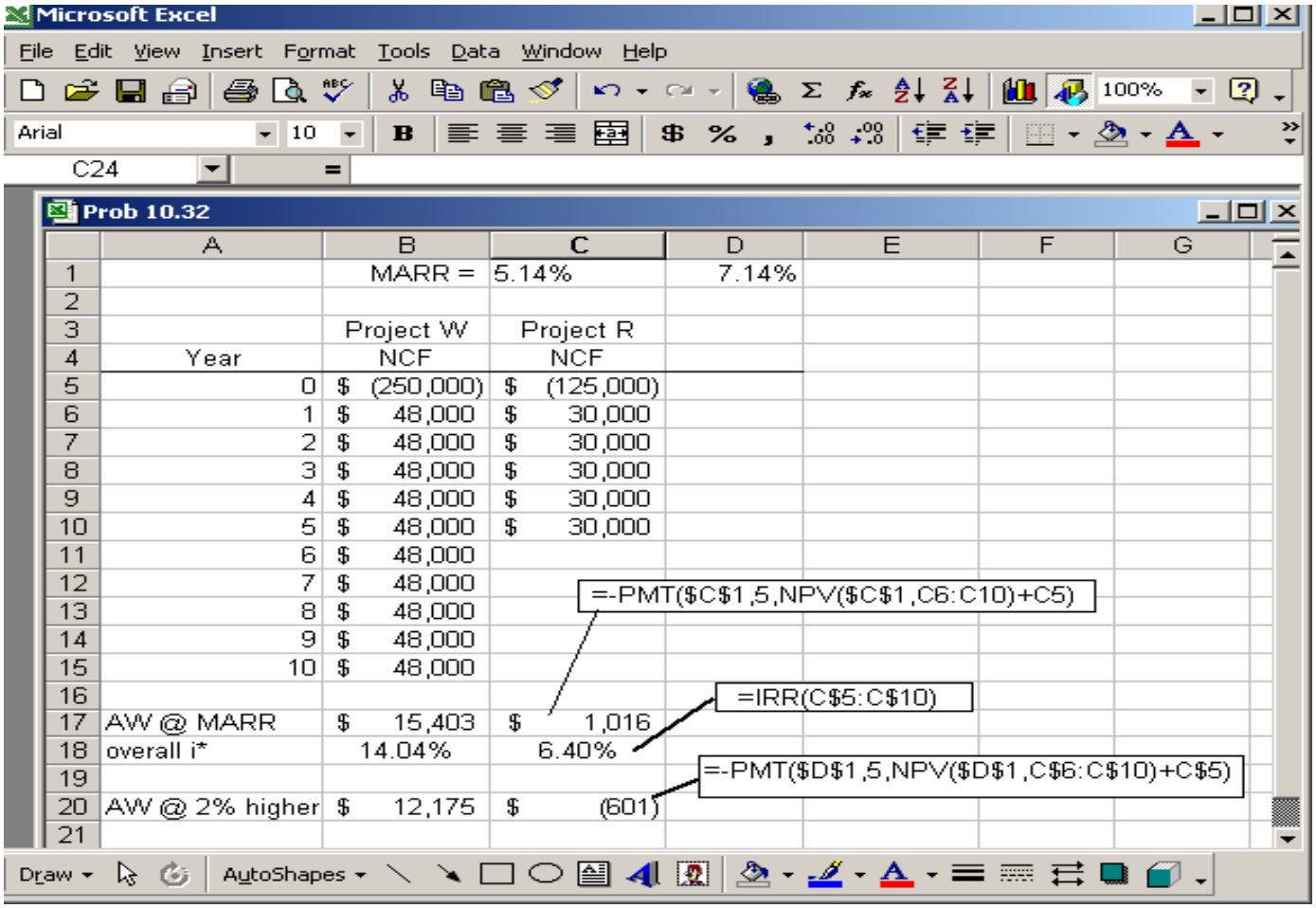
10.32 Two independent, revenue projects with different lives. Select all those with AW > 0.

Equity capital is 40% at a cost of 7.5% per year
Debt capital is 5% per year, compounded quarterly. Effective rate after taxes is

After-tax debt i* = $[(1 + 0.05/4)^{4} - 1] (1- 0.3) = 3.5665\%$ per year

WACC = 0.4(7.5%) + 0.6(3.5665%) = 5.14% per year

MARR = WACC = 5.14%



	A	B	C	D	E	F	G
1		MARR =	5.14%	7.14%			
2							
3		Project W	Project R				
4	Year	NCF	NCF				
5	0	$ (250,000)	$ (125,000)				
6	1	$ 48,000	$ 30,000				
7	2	$ 48,000	$ 30,000				
8	3	$ 48,000	$ 30,000				
9	4	$ 48,000	$ 30,000				
10	5	$ 48,000	$ 30,000				
11	6	$ 48,000					
12	7	$ 48,000					
13	8	$ 48,000					
14	9	$ 48,000					
15	10	$ 48,000					
16							
17	AW @ MARR	$ 15,403	$ 1,016				
18	overall i*	14.04%	6.40%				
19							
20	AW @ 2% higher	$ 12,175	$ (601)				
21							

(a) At MARR = 5.14%, select both independent projects.

(b) With 2% added for higher risk, only project W is acceptable.

10.35 <u>100% equity financing</u>

MARR = 8.5% is known. Determine PW at the MARR.

$$PW = -250,000 + 30,000(P/A,8.5\%,15) = \$-874$$

Conclusion: 100% equity does not meet the MARR requirement

60%-40% D-E financing

Loan principal = 250,000(0.60) = $150,000
Loan payment = 150,000(A/P,9%,15) = $18,609 per year

Cost of 60% debt capital is 9% for the loan.

WACC = 0.4(8.5%) + 0.6(9%) = 8.8%
MARR = 8.8%

Annual NCF = project NCF - loan payment = $11,391
Amount of equity invested = 250,000 - 150,000 = $100,000

PW = -100,000 + 11,391(P/A,8.8%,15) = $ -7,087

Conclusion: 60% debt-40% equity mix does not meet the MARR requirement

10.38 All points will increase, except the 0% debt value. The new WACC curve is relatively higher at both the 0% debt and 100% debt points and the minimum WACC point will move to the right.

Conclusion: The minimum WACC will increase with a higher D-E mix, since debt and equity cost curves rise relative to those for lower D-E mixes.

10.41

Attribute	Importance	Logic
1	100	Most important (100)
2	10	10% of problem
3	50	1/2(100)
4	37.5	0.75(50)
5	100	Same as #1
	297.5	

W_i = Score/297.5

10.41 (cont)

Attribute	W_i
1	0.336
2	0.034
3	0.168
4	0.126
5	0.336
	1.000

10.44 (a) Both sets of ratings give the same conclusion, alternative 1, but the consistency between raters should be improved somewhat. This result simply

shows that the weighted evaluation method is relatively insensitive to attribute weights when an alternative (1 here) is favored by high (or disfavored by low) weights.

(b) Vice president

Attribute	W_i	V_{ij} 1	2	3
1	0.10	3	4	10
2	0.40	28	40	28
3	0.50	50	40	45
		81	84	83

Select alternative 2

Assistant vice president

Attribute	W_i	V_{ij} for alternatives 1	2	3
1	0.50	15	20	50
2	0.40	28	40	28
3	0.10	10	8	9
		53	68	87

Select 3

Rating differences on alternatives by attribute can make a significant difference in the alternative selected, based on these results.

10.46. Sum the ratings in Table 10.5 over all six attributes.

	V_{ij} 1	2	3
Total	470	515	345

Select alternative 2; the same choice is made.

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

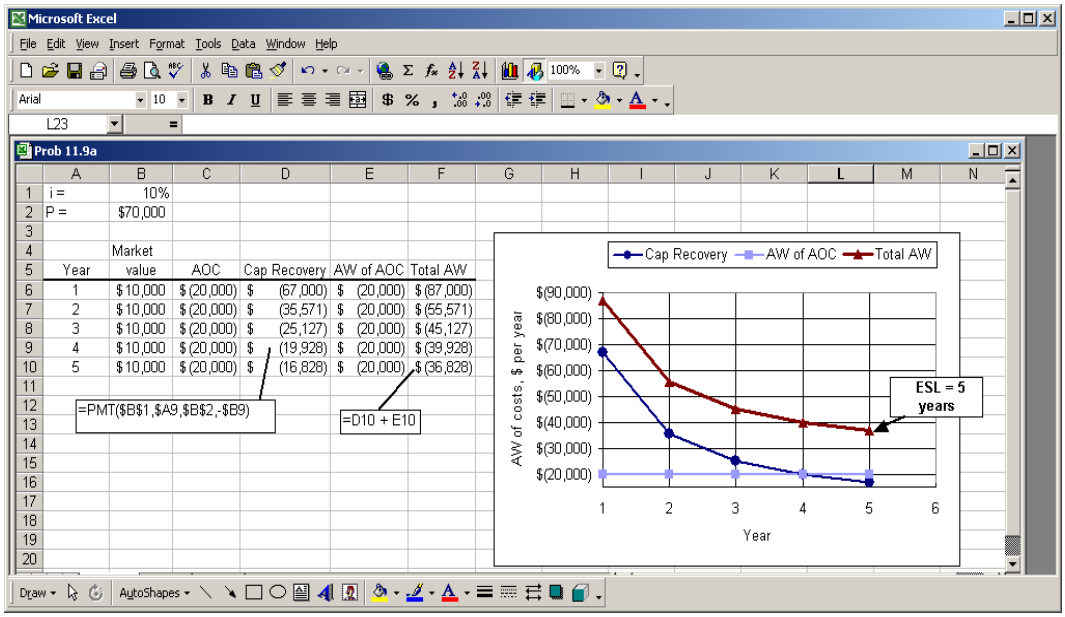
CHAPTER 11

Solutions included for problems 3, 5, 9, 11, 15, 17, 21, 24, 27, 30, 33, 36, and 39

11.3 The consultant's (external or outsider's) viewpoint is important to provide an unbiased analysis for both the defender and challenger, without owning or using either one.

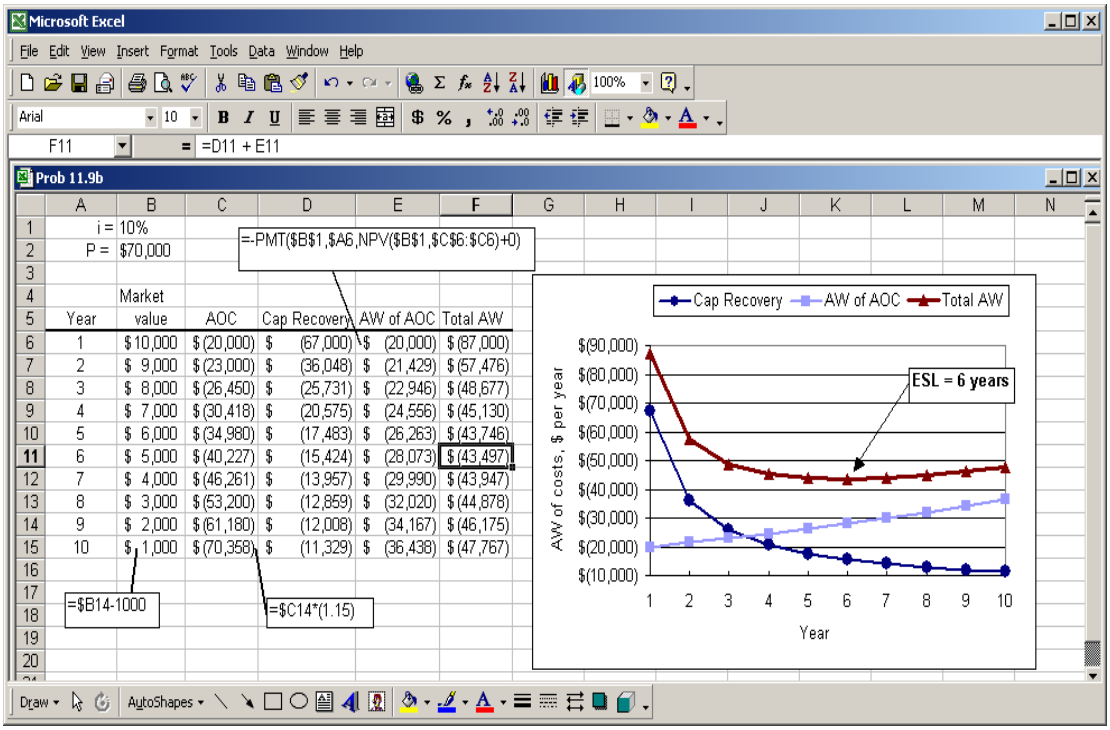
11.5 P = market value = $350,000
AOC = $125,000 per year
n = 2 years
S = $5,000

11.9 (a) The ESL is 5 years, as in Problem 11.8.



	A	B	C	D	E	F
1	i =	10%				
2	P =	$70,000				
3						
4		Market				
5	Year	value	AOC	Cap Recovery	AW of AOC	Total AW
6	1	$ 10,000	$ (20,000)	$ (67,000)	$ (20,000)	$ (87,000)
7	2	$ 10,000	$ (20,000)	$ (35,571)	$ (20,000)	$ (55,571)
8	3	$ 10,000	$ (20,000)	$ (25,127)	$ (20,000)	$ (45,127)
9	4	$ 10,000	$ (20,000)	$ (19,928)	$ (20,000)	$ (39,928)
10	5	$ 10,000	$ (20,000)	$ (16,828)	$ (20,000)	$ (36,828)

(b) On the same spreadsheet, decrease salvage by $1000 each year, and increase AOC by 15% per year. Extend the years to 10. The ESL is relatively insensitive between years 5 and 7, but the conclusion is ESL = 6 years.



11.11 (a) For n = 1: $AW_1 = -100{,}000(A/P,18\%,1) - 75{,}000 + 100{,}000(0.85)^1(A/F,18\%,1)$

$= \$ -108{,}000$

For n = 2: $AW_2 = -100{,}000(A/P,18\%,2) - 75{,}000 - 10{,}000(A/G,18\%,2)$
$+ 100{,}000(0.85)^2(A/F,18\%,2)$

$= \$ - 110{,}316$

ESL is 1 year with $AW_1 = \$-108{,}000$.

(b) Set the AW relation for year 6 equal to $AW_1 = \$-108{,}000$ and solve for P, the required lower first cost.

$AW_6 = -108{,}000 = -P(A/P,18\%,6) - 75{,}000 - 10{,}000(A/G,18\%,6)$
$+ P(0.85)^6(A/F,18\%,6)$

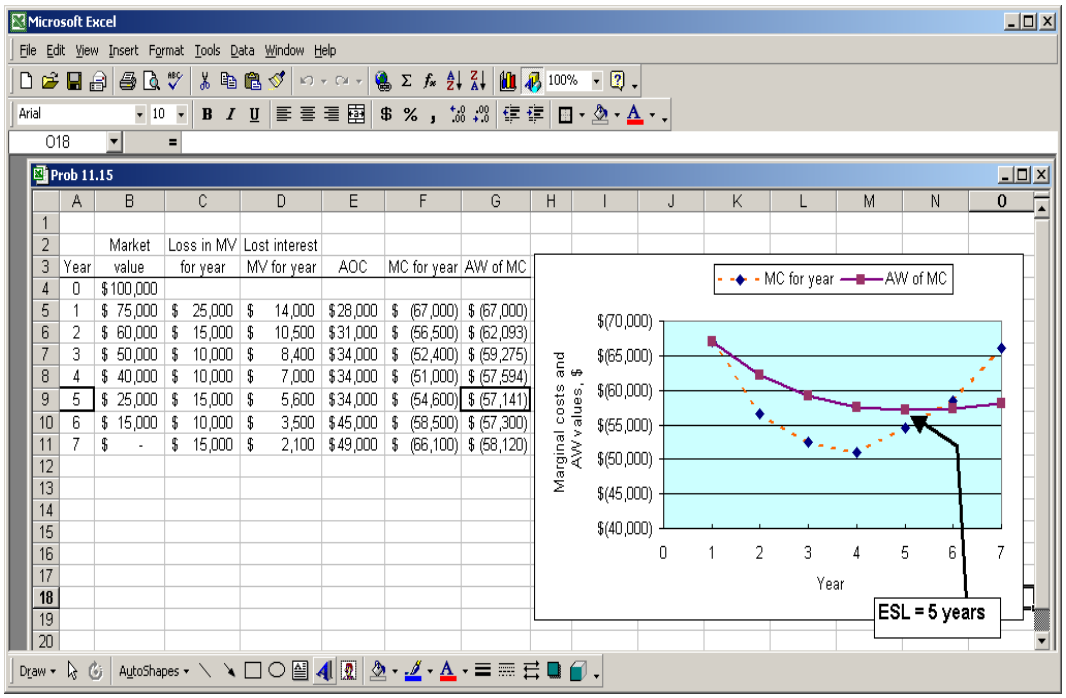
$-108{,}000 = -P(0.28591) - 75{,}000 - 10{,}000(2.0252) + P(0.37715)(0.10591)$

$0.24597P = -95{,}252 + 108{,}000$

$P = \$51{,}828$

The first cost would have to be reduced from $100,000 to $51,828. This is a quite large reduction.

11.15 Spreadsheet and marginal costs used to find the ESL of 5 years with AW = $-57,141.



Year	Market value	Loss in MV for year	Lost interest MV for year	AOC	MC for year	AW of MC
0	$100,000					
1	$ 75,000	$ 25,000	$ 14,000	$28,000	$ (67,000)	$ (67,000)
2	$ 60,000	$ 15,000	$ 10,500	$31,000	$ (56,500)	$ (62,093)
3	$ 50,000	$ 10,000	$ 8,400	$34,000	$ (52,400)	$ (59,275)
4	$ 40,000	$ 10,000	$ 7,000	$34,000	$ (51,000)	$ (57,594)
5	$ 25,000	$ 15,000	$ 5,600	$34,000	$ (54,600)	$ (57,141)
6	$ 15,000	$ 10,000	$ 3,500	$45,000	$ (58,500)	$ (57,300)
7	$ -	$ 15,000	$ 2,100	$49,000	$ (66,100)	$ (58,120)

11.17 Defender: ESL = 3 years with AW_D = $-47,000
Challenger: ESL = 2 years with AW_C = $-49,000

Recommendation now is to retain the defender for 3 years, then replace.

11.21 (a) The n values are set; calculate the AW values directly and select D or C.

$$AW_D = -50{,}000(A/P,10\%,5) - 160{,}000$$
$$= \$-173{,}190$$

$$AW_C = -700{,}000(A/P,10\%,10) - 150{,}000 + 50{,}000(A/F,10\%,10)$$
$$= \$-260{,}788$$

Retain the current bleaching system for 5 more years.

(b) Find the replacement value for the current process.

$$-RV(A/P,10\%,5) - 160{,}000 = AW_C = -260{,}788$$
$$RV = \$382{,}060$$

This is 85% of the first cost 7 years ago; way too high for a trade-in value now.

11.24 (a) By hand: Find ESL of the defender; compare with AW_C over 5 years.

For n = 1: $AW_D = -8000(A/P,15\%,1) - 50{,}000 + 6000(A/F,15\%,1)$

= $-53,200

For n = 2: AW_D = -8000(A/P,15%,2) – 50,000 + (-3000 + 4000)(A/F,15%,2)
= $-54,456

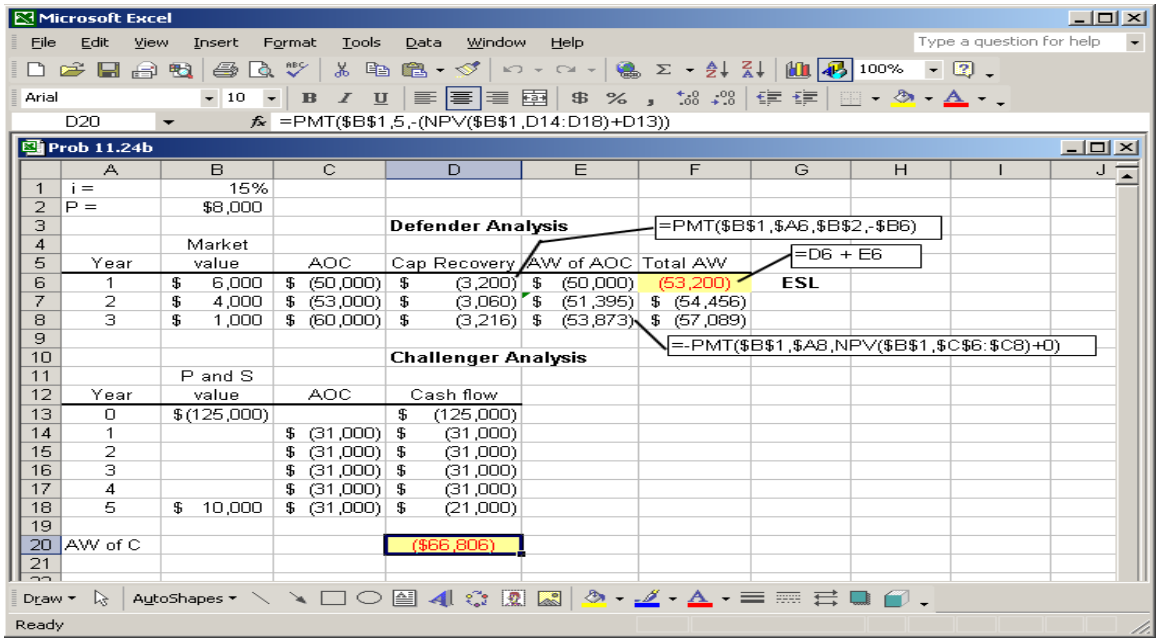
For n = 3: AW_D = -8000(A/P,15%,3) - [50,000(P/F,15%,1) +
= -$57,089

The ESL is now 1 year with AW_D = $-53,200

AW_C = -125,000(A/P,15%,5) – 31,000 + 10,000(A/F,15%,5)
= $-66,807

Since the ESL AW value is lower that the challenger AW, Richter should keep the defender now and replace it after 1 year.

(b) To make the decision, compare AW values.
AW_D = $-53,200
AW_C = $-66,806
Select the defender now and replaced after one year.



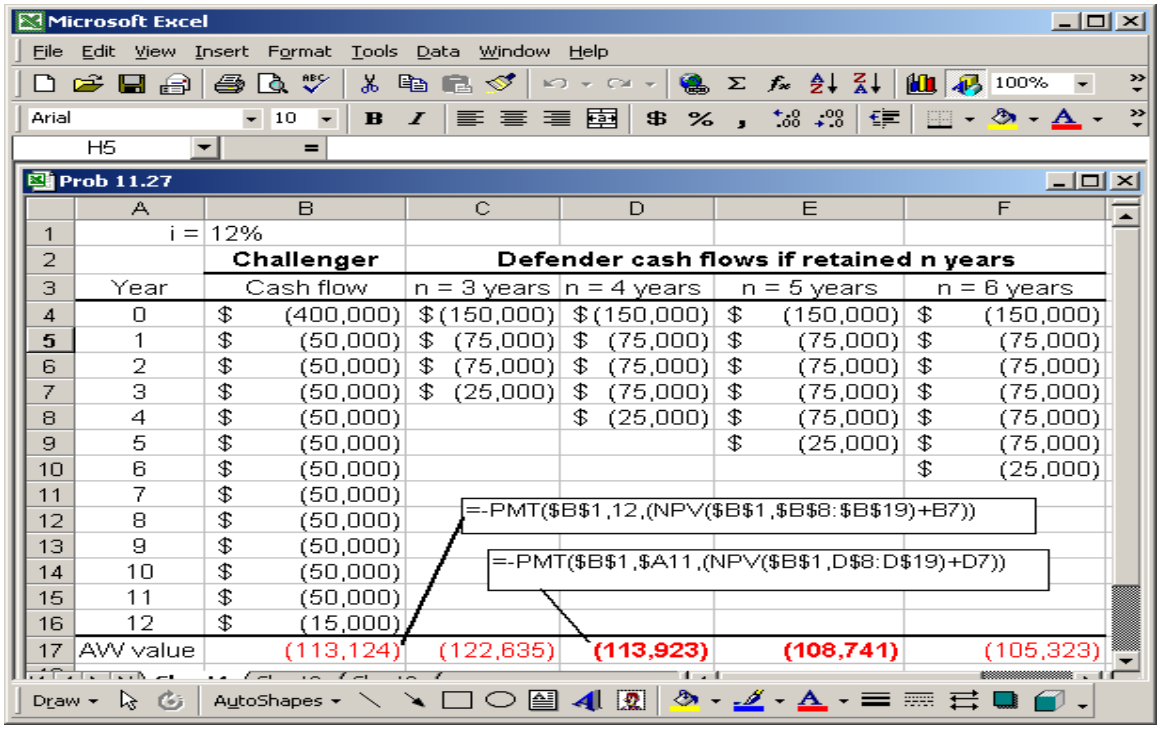
	A	B	C	D	E	F	G	H	I	J
1	i =	15%								
2	P =	$8,000								
3				**Defender Analysis**						
4		Market								
5	Year	value	AOC	Cap Recovery	AW of AOC	Total AW				
6	1	$ 6,000	$ (50,000)	$ (3,200)	$ (50,000)	(53,200)	**ESL**			
7	2	$ 4,000	$ (53,000)	$ (3,060)	$ (51,395)	$ (54,456)				
8	3	$ 1,000	$ (60,000)	$ (3,216)	$ (53,873)	$ (57,089)				
9										
10				**Challenger Analysis**						
11		P and S								
12	Year	value	AOC	Cash flow						
13	0	$(125,000)		$ (125,000)						
14	1		$ (31,000)	$ (31,000)						
15	2		$ (31,000)	$ (31,000)						
16	3		$ (31,000)	$ (31,000)						
17	4		$ (31,000)	$ (31,000)						
18	5	$ 10,000	$ (31,000)	$ (21,000)						
19										
20	AW of C			($66,806)						
21										

11.27 (a) By hand: Find the replacement value (RV) for the in-place system.

-RV(A/P,12%,7) – 75,000 + 50,000(A/F,12%,7) = -400,000(A/P,12%,12)
– 50,000 + 35,000(A/F,12%,12)

RV = $196,612

11.27 (cont) (b) By spreadsheet: One approach is to set up the defender cash flows for increasing n values and use the PMT function to find AW. Just over 4 years will give the same AW values.



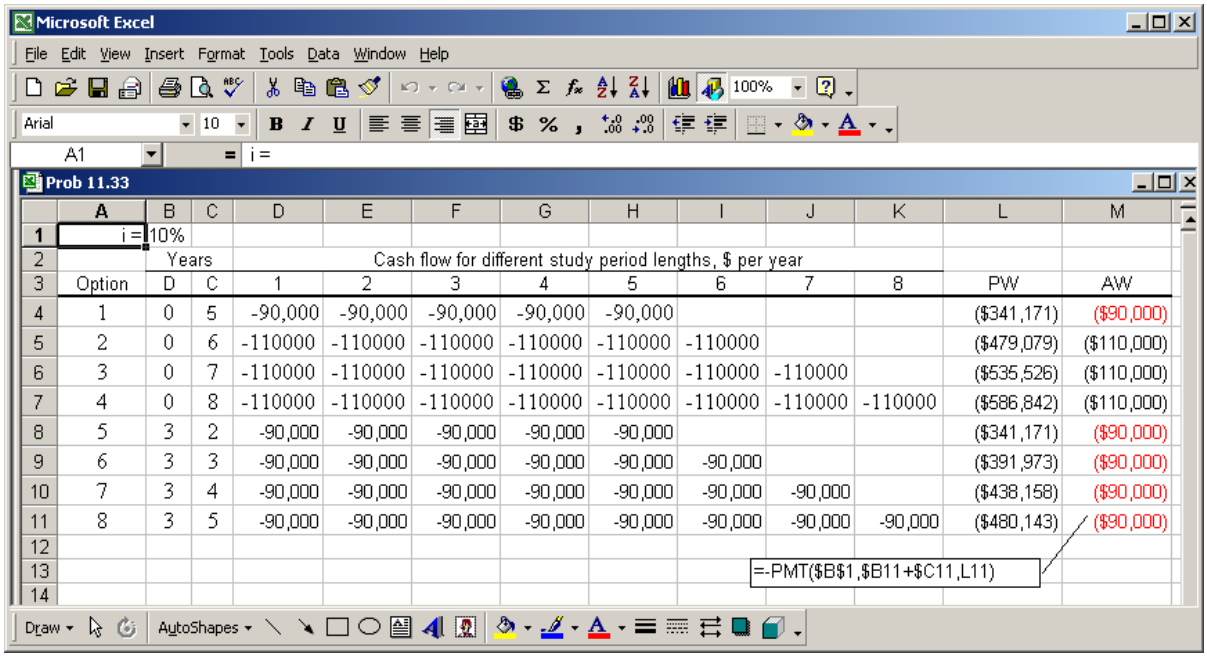
	A	B	C	D	E	F
1	i =	12%				
2		**Challenger**	**Defender cash flows if retained n years**			
3	Year	Cash flow	n = 3 years	n = 4 years	n = 5 years	n = 6 years
4	0	$ (400,000)	$ (150,000)	$ (150,000)	$ (150,000)	$ (150,000)
5	1	$ (50,000)	$ (75,000)	$ (75,000)	$ (75,000)	$ (75,000)
6	2	$ (50,000)	$ (75,000)	$ (75,000)	$ (75,000)	$ (75,000)
7	3	$ (50,000)	$ (25,000)	$ (75,000)	$ (75,000)	$ (75,000)
8	4	$ (50,000)		$ (25,000)	$ (75,000)	$ (75,000)
9	5	$ (50,000)			$ (25,000)	$ (75,000)
10	6	$ (50,000)				$ (25,000)
11	7	$ (50,000)				
12	8	$ (50,000)				
13	9	$ (50,000)				
14	10	$ (50,000)				
15	11	$ (50,000)				
16	12	$ (15,000)				
17	AW value	(113,124)	(122,635)	**(113,923)**	**(108,741)**	(105,323)

11.30 (a) If no study period is specified, the three replacement study assumptions in Section 11.1 hold. So, the services of the defender and challenger can be obtained (it is assumed) at their AW values. When a study period is specified these assumptions are not made and repeatability of either D or C alternatives is not a consideration.

(b) If a study period is specified, all viable options must be evaluated. Without a study period, the ESL analysis or the AW values at set n values determine the AW values for D and C. Selection of the best option concludes the study.

11.33 (a)

Option	Defender	Challenger
1	0	5
2	0	6
3	0	7
4	0	8
5	3	2
6	3	3
7	3	4
8	3	5



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	i =	10%											
2		Years		Cash flow for different study period lengths, $ per year									
3	Option	D	C	1	2	3	4	5	6	7	8	PW	AW
4	1	0	5	-90,000	-90,000	-90,000	-90,000	-90,000				($341,171)	($90,000)
5	2	0	6	-110000	-110000	-110000	-110000	-110000	-110000			($479,079)	($110,000)
6	3	0	7	-110000	-110000	-110000	-110000	-110000	-110000	-110000		($535,526)	($110,000)
7	4	0	8	-110000	-110000	-110000	-110000	-110000	-110000	-110000	-110000	($586,842)	($110,000)
8	5	3	2	-90,000	-90,000	-90,000	-90,000	-90,000				($341,171)	($90,000)
9	6	3	3	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000			($391,973)	($90,000)
10	7	3	4	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000		($438,158)	($90,000)
11	8	3	5	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000	-90,000	($480,143)	($90,000)
12													
13													
14													

A total of 5 options have AW = $-90,000. Several ways to go; defender can be replaced now or after 3 years and challenger can be used from 2 to 5 years, depending on the option chosen.

(b) PW values cannot be used to select best options since the equal-service assumption is violated due to study periods of different lengths. Must us AW values.

11.36 Answer is (a)

11.39 Answer is (c)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 12

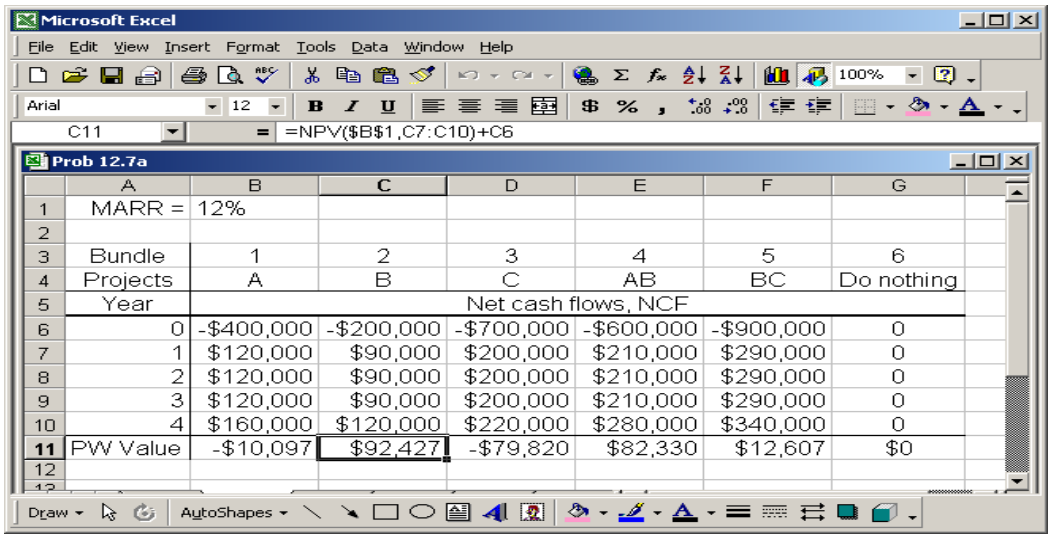
Solutions included for problems: 2, 4, 7, 10, 13, 15, 19, 22, and 25

12.2 Any net positive cash flows that occur in any project are reinvested at the MARR from the time they are realized until the end of the longest-lived project being evaluated. In effect, this makes the lives equal for all projects, a requirement to correctly apply the PW method.

12.4 Considering the $400 limitation, the viable bundles are:

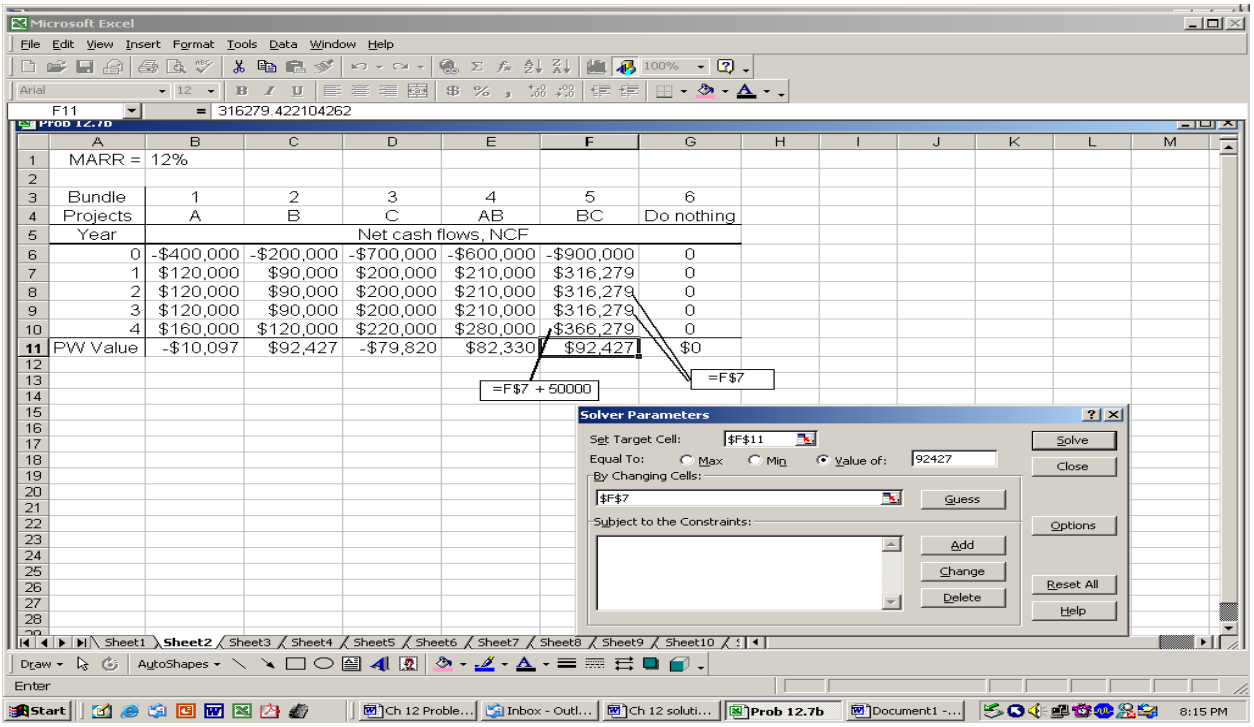
Projects	Investment
DN	$ 0
2	150
3	75
4	235
2, 3	225
2, 4	385
3, 4	310

12.7 (a) Select project B for a total of $200,000, since it is the only one of the three single projects with PW > 0 at MARR = 12% per year.



	A	B	C	D	E	F	G
1	MARR =	12%					
2							
3	Bundle	1	2	3	4	5	6
4	Projects	A	B	C	AB	BC	Do nothing
5	Year	Net cash flows, NCF					
6	0	-$400,000	-$200,000	-$700,000	-$600,000	-$900,000	0
7	1	$120,000	$90,000	$200,000	$210,000	$290,000	0
8	2	$120,000	$90,000	$200,000	$210,000	$290,000	0
9	3	$120,000	$90,000	$200,000	$210,000	$290,000	0
10	4	$160,000	$120,000	$220,000	$280,000	$340,000	0
11	PW Value	-$10,097	$92,427	-$79,820	$82,330	$12,607	$0
12							

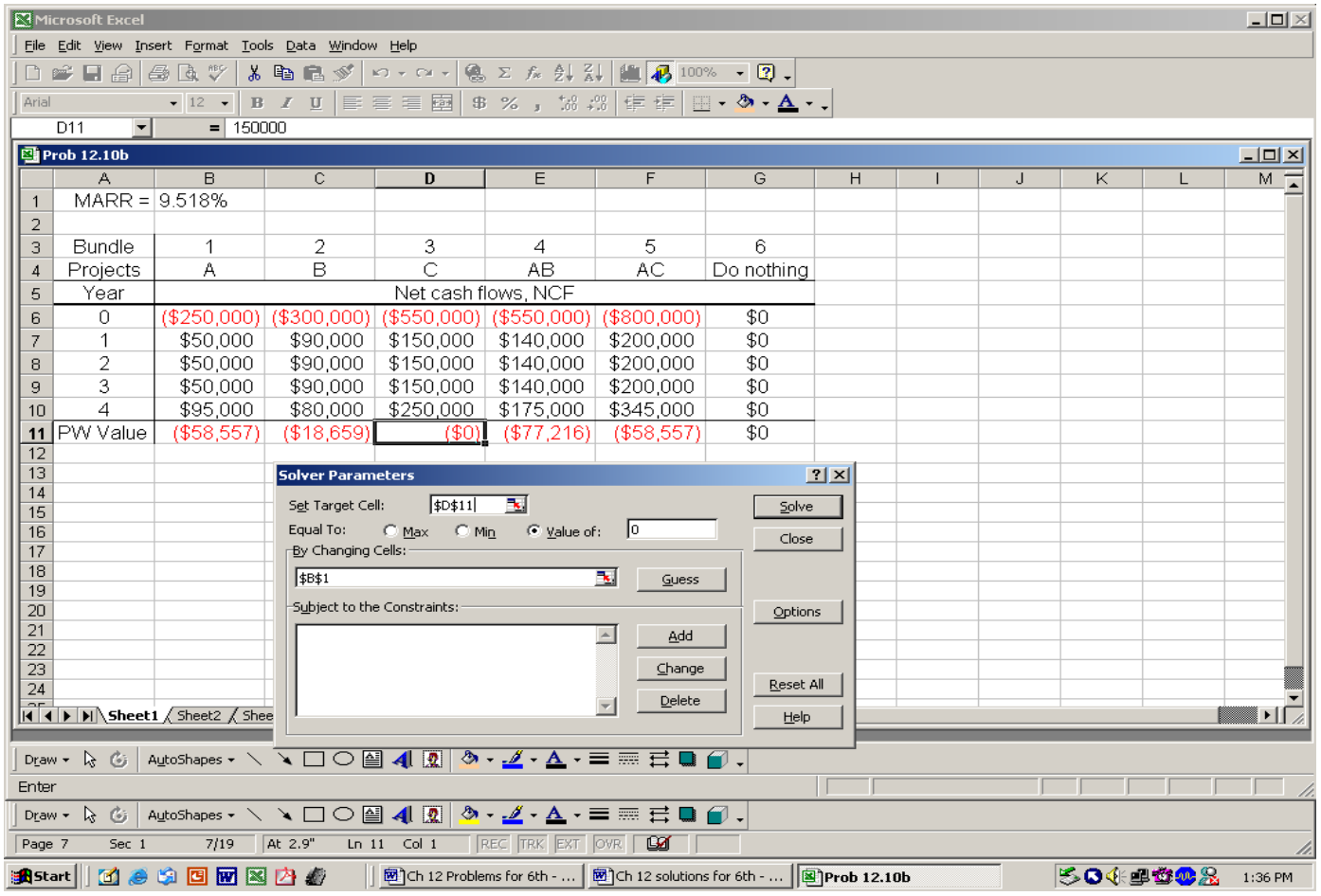
12.7 (cont) (b) Use SOLVER to find the necessary minimum NCF.


Microsoft Excel
File Edit View Insert Format Tools Data Window Help
F11
316279.422104262
Prob 12.7b
MARR = 12%
Bundle 1 2 3 4 5 6
Projects A B C AB BC Do nothing
Year Net cash flows, NCF
0 -$400,000 -$200,000 -$700,000 -$600,000 -$900,000 0
1 $120,000 $90,000 $200,000 $210,000 $316,279 0
2 $120,000 $90,000 $200,000 $210,000 $316,279 0
3 $120,000 $90,000 $200,000 $210,000 $316,279 0
4 $160,000 $120,000 $220,000 $280,000 $366,279 0
PW Value -$10,097 $92,427 -$79,820 $82,330 $92,427 $0
=F$7 + 50000
=F$7
Solver Parameters
Set Target Cell: F11
Equal To: Max Min Value of: 92427
By Changing Cells:
F7
Subject to the Constraints:
Solve
Close
Guess
Options
Add
Change
Delete
Reset All
Help
Sheet1 Sheet2 Sheet3 Sheet4 Sheet5 Sheet6 Sheet7 Sheet8 Sheet9 Sheet10
Draw AutoShapes
Enter
Start
Ch 12 Proble...
Inbox - Outl...
Ch 12 soluti...
Prob 12.7b
Document1 -...
8:15 PM

12.10 (a) Set up spreadsheet and determine that the Do Nothing bundle is the only acceptable one, and that PW_C = \$-6219. Since the initial investment occurs at time t = 0, maximum initial investment for C at which PW = 0 is

-550,000 + (-6219) = \$-543,781

(b) Use SOLVER with the target cell as PW = 0 for project C. Result is MARR = 9.518%.



	A	B	C	D	E	F	G
1	MARR =	9.518%					
2							
3	Bundle	1	2	3	4	5	6
4	Projects	A	B	C	AB	AC	Do nothing
5	Year	Net cash flows, NCF					
6	0	($250,000)	($300,000)	($550,000)	($550,000)	($800,000)	$0
7	1	$50,000	$90,000	$150,000	$140,000	$200,000	$0
8	2	$50,000	$90,000	$150,000	$140,000	$200,000	$0
9	3	$50,000	$90,000	$150,000	$140,000	$200,000	$0
10	4	$95,000	$80,000	$250,000	$175,000	$345,000	$0
11	PW Value	($58,557)	($18,659)	($0)	($77,216)	($58,557)	$0

12.13 (a) PW values are determined at MARR = 15% per year.

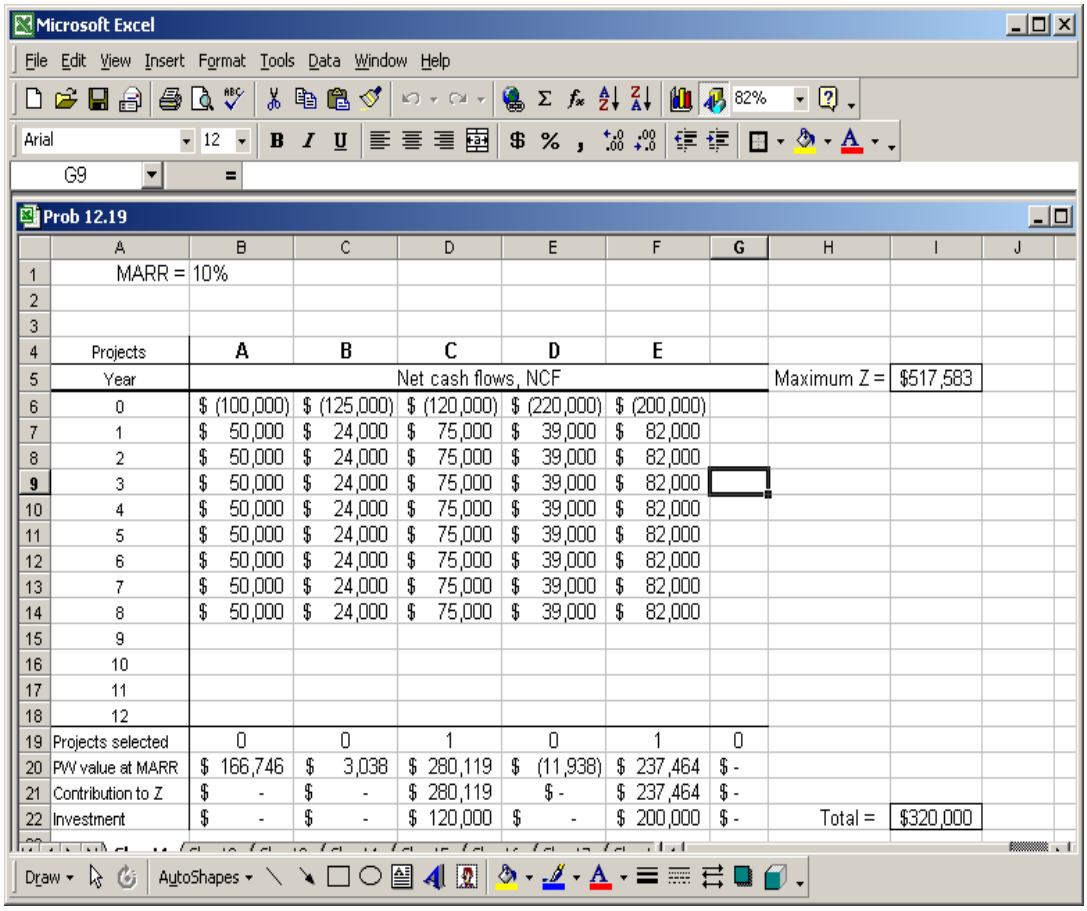
Bundle	Projects	Initial investment, $	NCF, $ per year	Life, years	PW at 15%
1	1	-1.5 mil	360,000	8	$115,428
2	2	-3.0	600,000	10	11,280
3	3	-1.8	520,000	5	- 56,856
4	4	-2.0	820,000	4	341,100
5	1,3	-3.3	880,000	1-5	58,572
			360,000	6-8	
6	1,4	-3.5	1,180,000	1-4	456,528
			360,000	5-8	
7	3,4	-3.8	1,340,000	1-4	284,244
			520,000	5	

Select projects 1 and 4 with $3.5 million invested.

12.15 Budget limit, b = $16,000 MARR = 12% per year

Bundle	Projects	Investment	NCF for years 1 through 5	PW at 12%
1	1	$-5,000	$1000,1700,2400, 3000,3800	$3019
2	2	- 8,000	500,500,500, 500,10500	- 523
3	3	- 9,000	5000,5000,2000	874
4	4	-10,000	0,0,0,17000	804
5	1,2	-13,000	1500,2200,2900, 3500,14300	2496
6	1,3	-14,000	6000,6700,4400, 3000,3800	3893
7	1,4	-15,000	1000,1700,2400, 20000,3800	3823

12.19 (a) Select projects C and E.



Microsoft Excel

File Edit View Insert Format Tools Data Window Help

Arial 12 G9

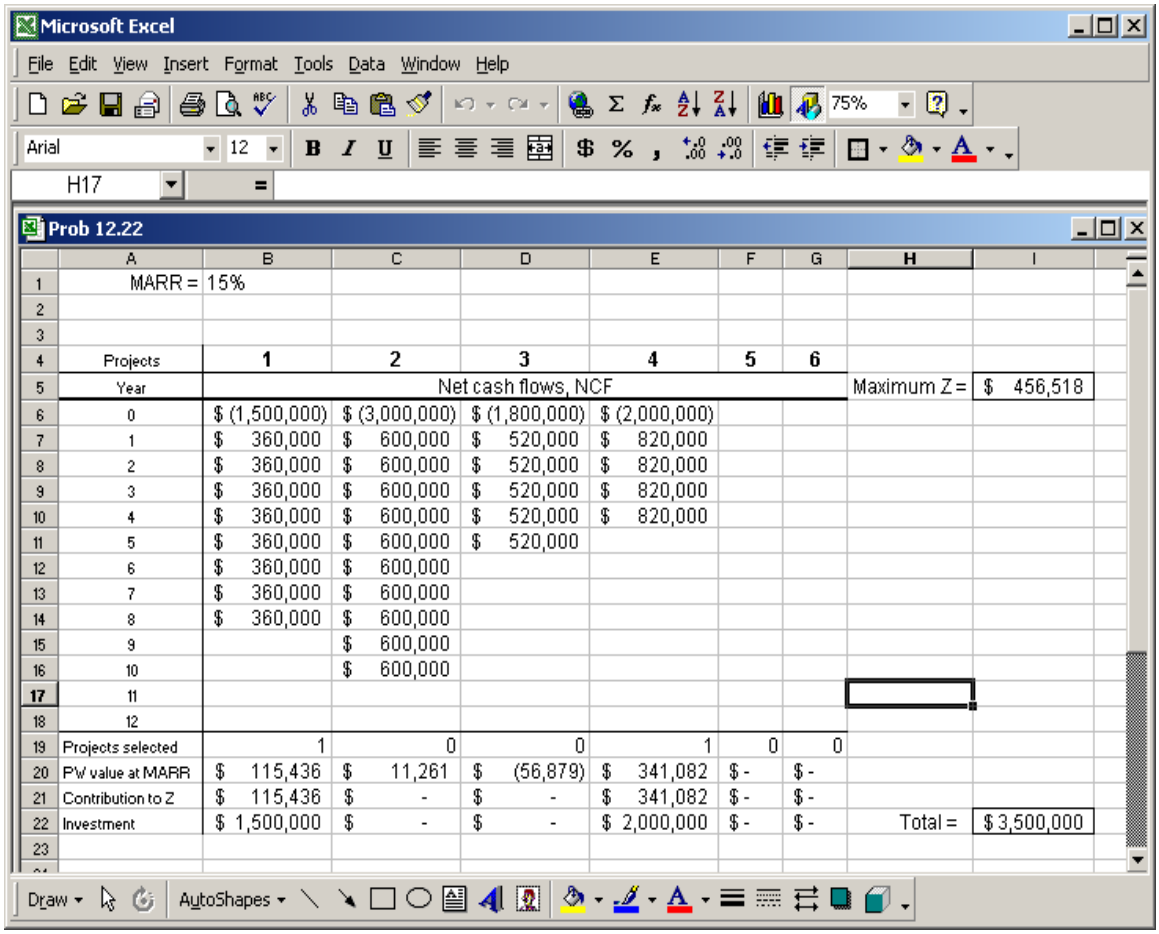
Prob 12.19

	A	B	C	D	E	F	G	H	I	J
1	MARR =	10%								
2										
3										
4	Projects	A	B	C	D	E				
5	Year	Net cash flows, NCF						Maximum Z =	$517,583	
6	0	$ (100,000)	$ (125,000)	$ (120,000)	$ (220,000)	$ (200,000)				
7	1	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
8	2	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
9	3	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
10	4	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
11	5	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
12	6	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
13	7	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
14	8	$ 50,000	$ 24,000	$ 75,000	$ 39,000	$ 82,000				
15	9									
16	10									
17	11									
18	12									
19	Projects selected	0	0	1	0	1	0			
20	PW value at MARR	$ 166,746	$ 3,038	$ 280,119	$ (11,938)	$ 237,464	$ -			
21	Contribution to Z	$ -	$ -	$ 280,119	$ -	$ 237,464	$ -			
22	Investment	$ -	$ -	$ 120,000	$ -	$ 200,000	$ -	Total =	$320,000	

Draw AutoShapes

(b) Change MARR to 12% and the budget constraint to $500,000. Select projects A, C and E.

12.22 Select projects 1 and 4 with $3.5 million invested.



Microsoft Excel

File Edit View Insert Format Tools Data Window Help

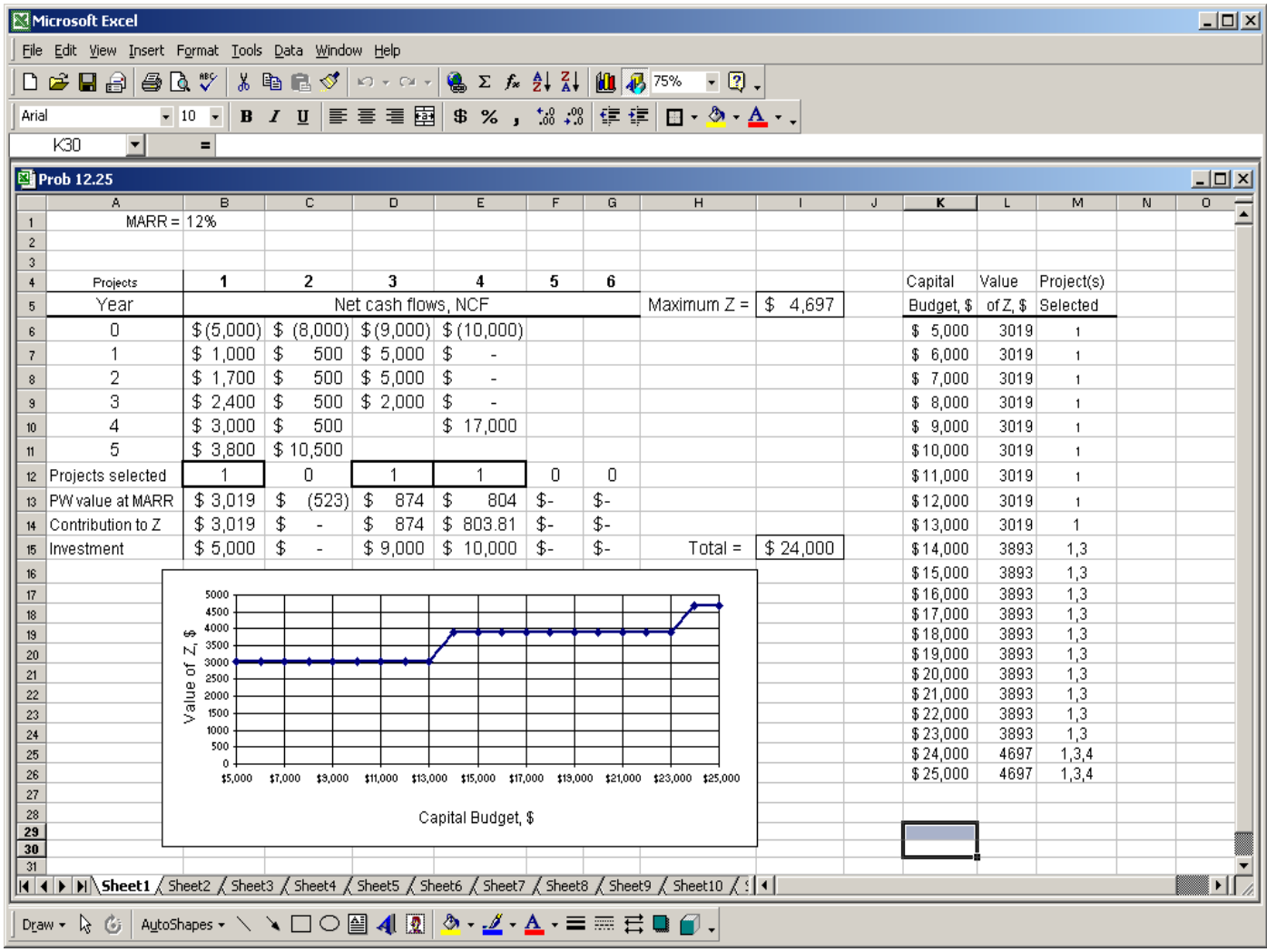
Arial 12 H17

Prob 12.22

	A	B	C	D	E	F	G	H	I
1	MARR =	15%							
2									
3									
4	Projects	1	2	3	4	5	6		
5	Year	Net cash flows, NCF						Maximum Z =	$ 456,518
6	0	$ (1,500,000)	$ (3,000,000)	$ (1,800,000)	$ (2,000,000)				
7	1	$ 360,000	$ 600,000	$ 520,000	$ 820,000				
8	2	$ 360,000	$ 600,000	$ 520,000	$ 820,000				
9	3	$ 360,000	$ 600,000	$ 520,000	$ 820,000				
10	4	$ 360,000	$ 600,000	$ 520,000	$ 820,000				
11	5	$ 360,000	$ 600,000	$ 520,000					
12	6	$ 360,000	$ 600,000						
13	7	$ 360,000	$ 600,000						
14	8	$ 360,000	$ 600,000						
15	9		$ 600,000						
16	10		$ 600,000						
17	11								
18	12								
19	Projects selected	1	0	0	1	0	0		
20	PW value at MARR	$ 115,436	$ 11,261	$ (56,879)	$ 341,082	$ -	$ -		
21	Contribution to Z	$ 115,436	$ -	$ -	$ 341,082	$ -	$ -		
22	Investment	$ 1,500,000	$ -	$ -	$ 2,000,000	$ -	$ -	Total =	$ 3,500,000
23									

Draw AutoShapes

12.25 Use SOLVER repeatedly to find the best projects and corresponding value of Z. Develop an Excel chart for the two series.



Microsoft Excel — Prob 12.25

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	MARR =	12%													
2															
3															
4	Projects	1	2	3	4	5	6				Capital	Value	Project(s)		
5	Year	Net cash flows, NCF						Maximum Z =	$ 4,697		Budget, $	of Z, $	Selected		
6	0	$ (5,000)	$ (8,000)	$ (9,000)	$ (10,000)						$ 5,000	3019	1		
7	1	$ 1,000	$ 500	$ 5,000	$ -						$ 6,000	3019	1		
8	2	$ 1,700	$ 500	$ 5,000	$ -						$ 7,000	3019	1		
9	3	$ 2,400	$ 500	$ 2,000	$ -						$ 8,000	3019	1		
10	4	$ 3,000	$ 500		$ 17,000						$ 9,000	3019	1		
11	5	$ 3,800	$ 10,500								$ 10,000	3019	1		
12	Projects selected	1	0	1	1	0	0				$ 11,000	3019	1		
13	PW value at MARR	$ 3,019	$ (523)	$ 874	$ 804	$-	$-				$ 12,000	3019	1		
14	Contribution to Z	$ 3,019	$ -	$ 874	$ 803.81	$-	$-				$ 13,000	3019	1		
15	Investment	$ 5,000	$ -	$ 9,000	$ 10,000	$-	$-	Total =	$ 24,000		$ 14,000	3893	1,3		
16											$ 15,000	3893	1,3		
17											$ 16,000	3893	1,3		
18											$ 17,000	3893	1,3		
19											$ 18,000	3893	1,3		
20											$ 19,000	3893	1,3		
21											$ 20,000	3893	1,3		
22											$ 21,000	3893	1,3		
23											$ 22,000	3893	1,3		
24											$ 23,000	3893	1,3		
25											$ 24,000	4697	1,3,4		
26											$ 25,000	4697	1,3,4		
27															
28															
29															
30															
31															

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 13

Solutions included for problems: 1, 5, 8, 11, 14, 17, 21, 23b, 26

13.1 (a) Q_{BE} = 1,000,000/(8.50-4.25) = 235,294 units

(b) Profit = 8.50Q – 1,000,000 - 4.25Q

at 200,000 units: Profit = $-150,000 (loss)

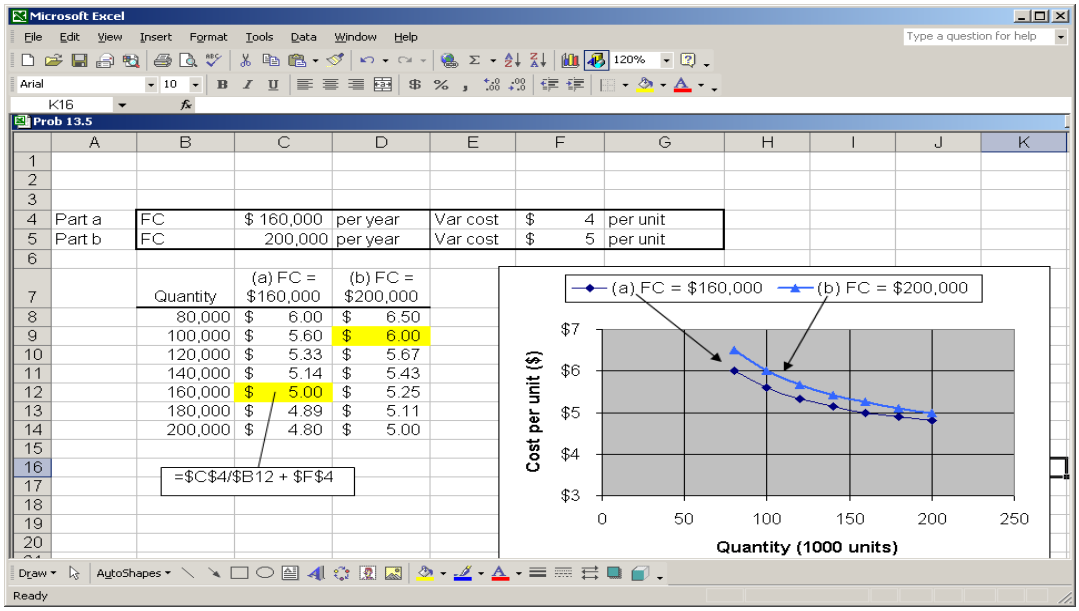
at 350,000 units: Profit = $487,500

13.5 From Equation [13.4], plot C_u = 160,000/Q + 4.

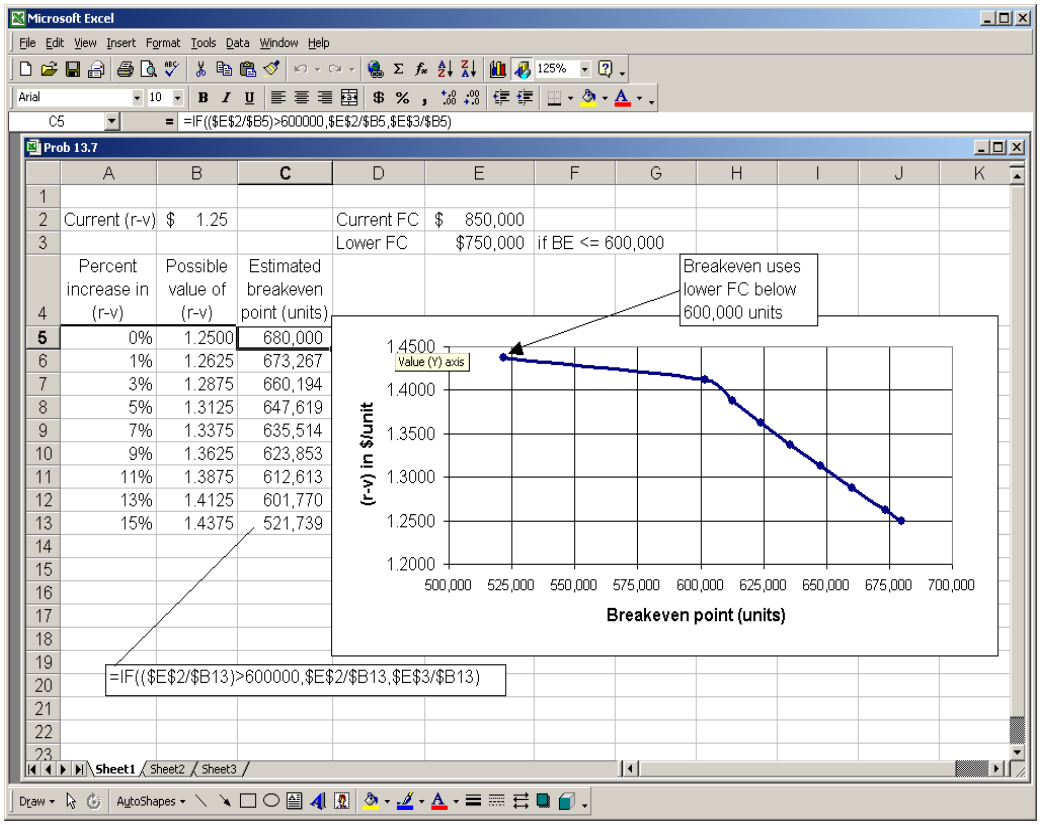
(a) If C_u = $5, from the graph, Q is approximately 160,000. If Q is determined by Equation [13.4], it is

5 = 160,000/Q + 4
Q = 160,000/1 = 160,000 units

(b) From the plot, or by equation, Q = 100,000 units.
C_u = 6 = 200,000/Q + 4
Q = 200,000/2 = 100,000 units



13.8 On spreadsheet for 13.7, include an IF statement for the computation of Q_{BE} for the reduced FC of $750,000. The breakeven point reduces to 521,739.



13.11 FC = \$305,000 v = \$5500/unit

(a) $\text{Profit} = (r - v)Q - FC$

$0 = (r - 5500)5000 - 305{,}000$

$(r - 5500) = 305{,}000 / 5000$

$r = \$5561$ per unit

(b) $\text{Profit} = (r - v)Q - FC$

$500{,}000 = (r - 5500)8000 - 305{,}000$

$(r - 5500) = (500{,}000 + 305{,}000) / 8000$

$r = \$5601$ per unit

13.14 Let x = hours per year

$$-800(A/P,10\%,3) - (300/2000)x - 1.0x = -1{,}900(A/P,10\%,5) - (700/8000)x - 1.0x$$

$$-800(0.40211) - 0.15x - 1.0x = -1{,}900(0.2638) - 0.0875x - 1.0x$$

$x = 2873$ hours per year

13.17 (a) Let x = breakeven days per year. Use annual worth analysis.

$$-125{,}000(A/P,12\%,8) + 5{,}000(A/F,12\%,8) - 2{,}000 - 40x = -45(125 + 20x)$$

$$-125{,}000(0.2013) + 5{,}000(0.0813) - 2{,}000 - 40x = -5625 - 900x$$

$x = 24.6$ days per year

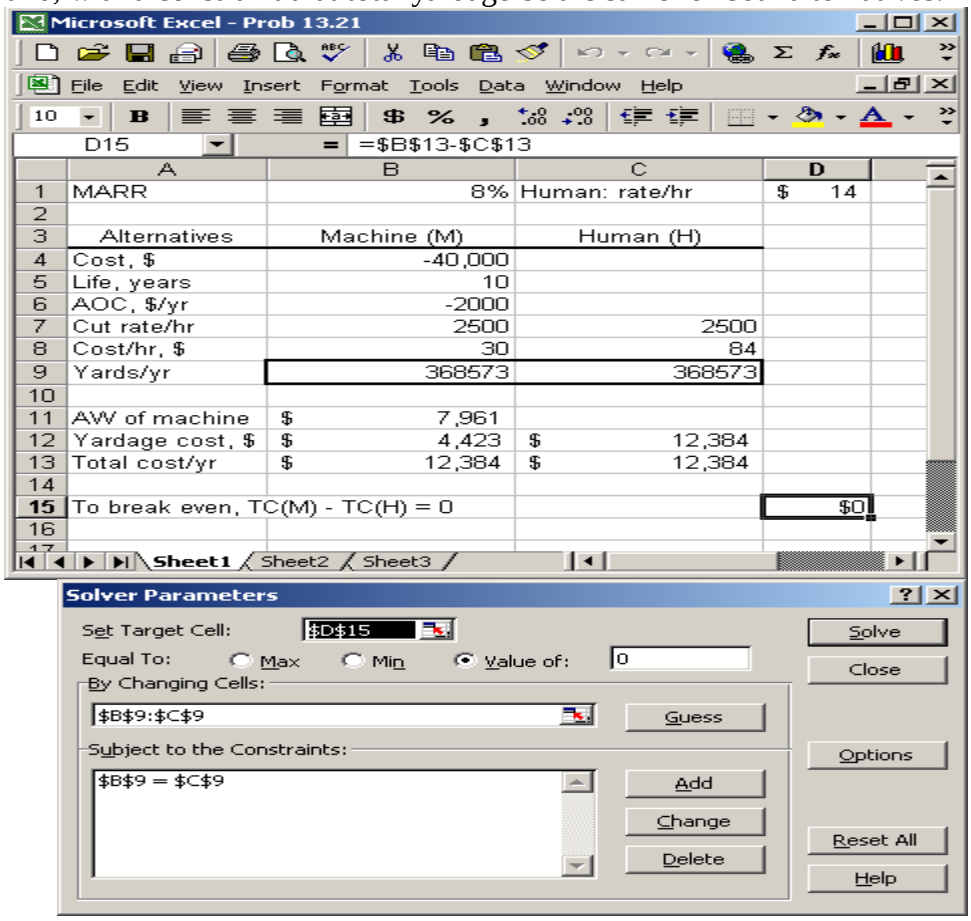
(b) Since 75 > 24.6 days, buy. Annual cost is $-29,756

13.21 Let x = yards per year to breakeven

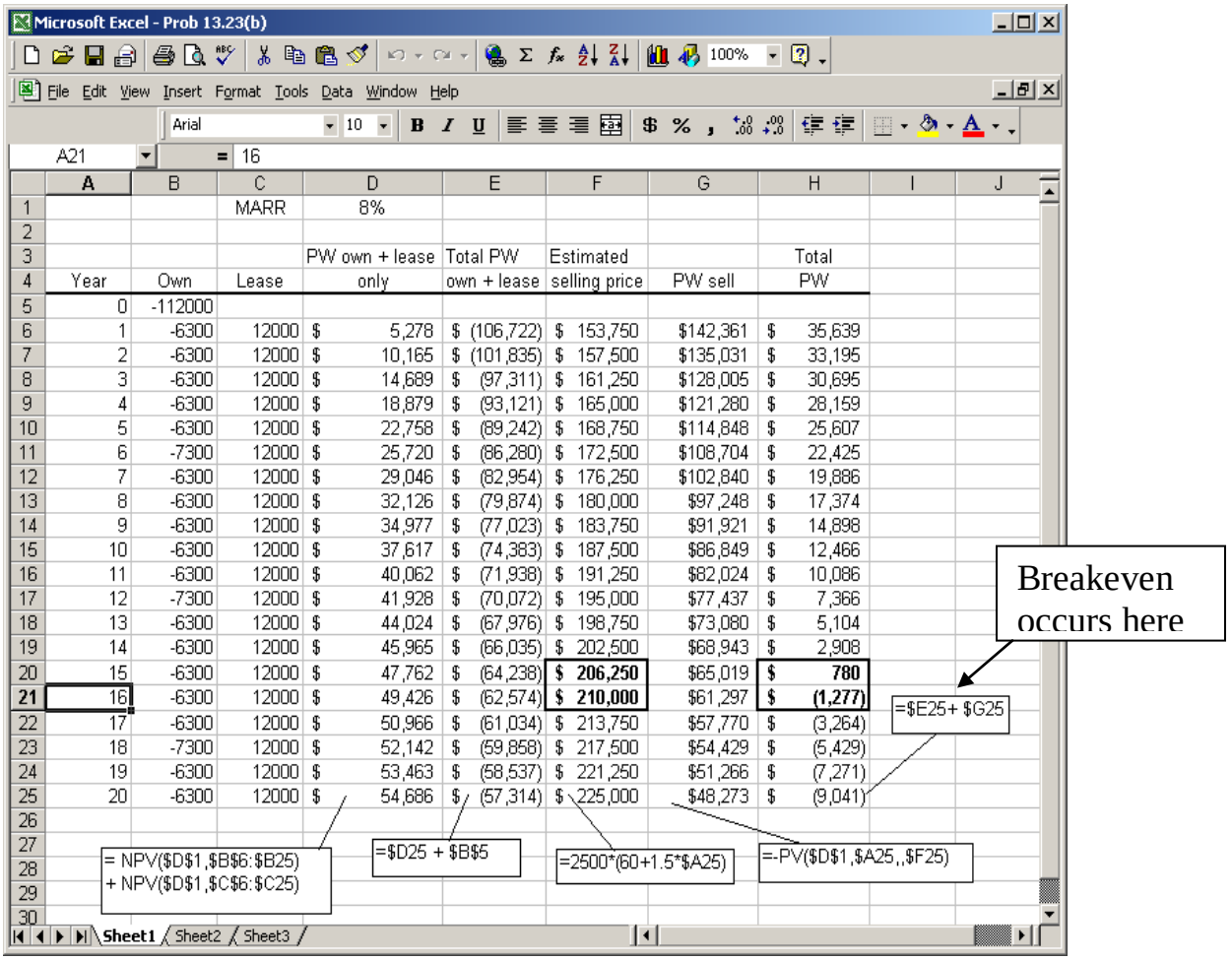
(a) Solution by hand

$$-40{,}000(A/P,8\%,10) - 2{,}000 - (30/2500)x = -[6(14)/2500]x$$
$$-40{,}000(0.14903) - 2{,}000 - 0.012x = -0.0336x$$
$$x = 368{,}574 \text{ yards per year}$$

(b) Solution by computer: There are many Excel set-ups to work the problem. One is: Enter the parameters for each alternative, including some number of yards per year as a guess. Use SOLVER to force the breakeven equation to equal 0, with a constraint that total yardage be the same for both alternatives.



13.23 (b) Enter the cash flows and develop the PW relations for each column. Breakeven is between 15 and 16 years. Selling price is estimated to be between $206,250 and $210,000.



	A	B	C	D	E	F	G	H
1			MARR	8%				
2								
3				PW own + lease	Total PW	Estimated		Total
4	Year	Own	Lease	only	own + lease	selling price	PW sell	PW
5	0	-112000						
6	1	-6300	12000	$ 5,278	$ (106,722)	$ 153,750	$142,361	$ 35,639
7	2	-6300	12000	$ 10,165	$ (101,835)	$ 157,500	$135,031	$ 33,195
8	3	-6300	12000	$ 14,689	$ (97,311)	$ 161,250	$128,005	$ 30,695
9	4	-6300	12000	$ 18,879	$ (93,121)	$ 165,000	$121,280	$ 28,159
10	5	-6300	12000	$ 22,758	$ (89,242)	$ 168,750	$114,848	$ 25,607
11	6	-7300	12000	$ 25,720	$ (86,280)	$ 172,500	$108,704	$ 22,425
12	7	-6300	12000	$ 29,046	$ (82,954)	$ 176,250	$102,840	$ 19,886
13	8	-6300	12000	$ 32,126	$ (79,874)	$ 180,000	$97,248	$ 17,374
14	9	-6300	12000	$ 34,977	$ (77,023)	$ 183,750	$91,921	$ 14,898
15	10	-6300	12000	$ 37,617	$ (74,383)	$ 187,500	$86,849	$ 12,466
16	11	-6300	12000	$ 40,062	$ (71,938)	$ 191,250	$82,024	$ 10,086
17	12	-7300	12000	$ 41,928	$ (70,072)	$ 195,000	$77,437	$ 7,366
18	13	-6300	12000	$ 44,024	$ (67,976)	$ 198,750	$73,080	$ 5,104
19	14	-6300	12000	$ 45,965	$ (66,035)	$ 202,500	$68,943	$ 2,908
20	15	-6300	12000	$ 47,762	$ (64,238)	**$ 206,250**	$65,019	**$ 780**
21	16	-6300	12000	$ 49,426	$ (62,574)	**$ 210,000**	$61,297	**$ (1,277)**
22	17	-6300	12000	$ 50,966	$ (61,034)	$ 213,750	$57,770	$ (3,264)
23	18	-7300	12000	$ 52,142	$ (59,858)	$ 217,500	$54,429	$ (5,429)
24	19	-6300	12000	$ 53,463	$ (58,537)	$ 221,250	$51,266	$ (7,271)
25	20	-6300	12000	$ 54,686	$ (57,314)	$ 225,000	$48,273	$ (9,041)

13.26 (a) By hand: Let P = first cost of sandblasting. Equate the PW of painting each 4 years to PW of sandblasting each 10 years, up to 38 years.

PW of painting

PW_p = -2,800 - 3,360(P/F,10%,4) - 4,032(P/F,10%,8) - 4,838(P/F,10%12) – 5,806(P/F,10%,16) - 6,967(P/F,10%,20) -8,361(P/F,10%,24) – 10,033(P/F,10%,28) - 12,039(P/F,10%,32) -14,447(P/F,10%,36)

= $-13,397

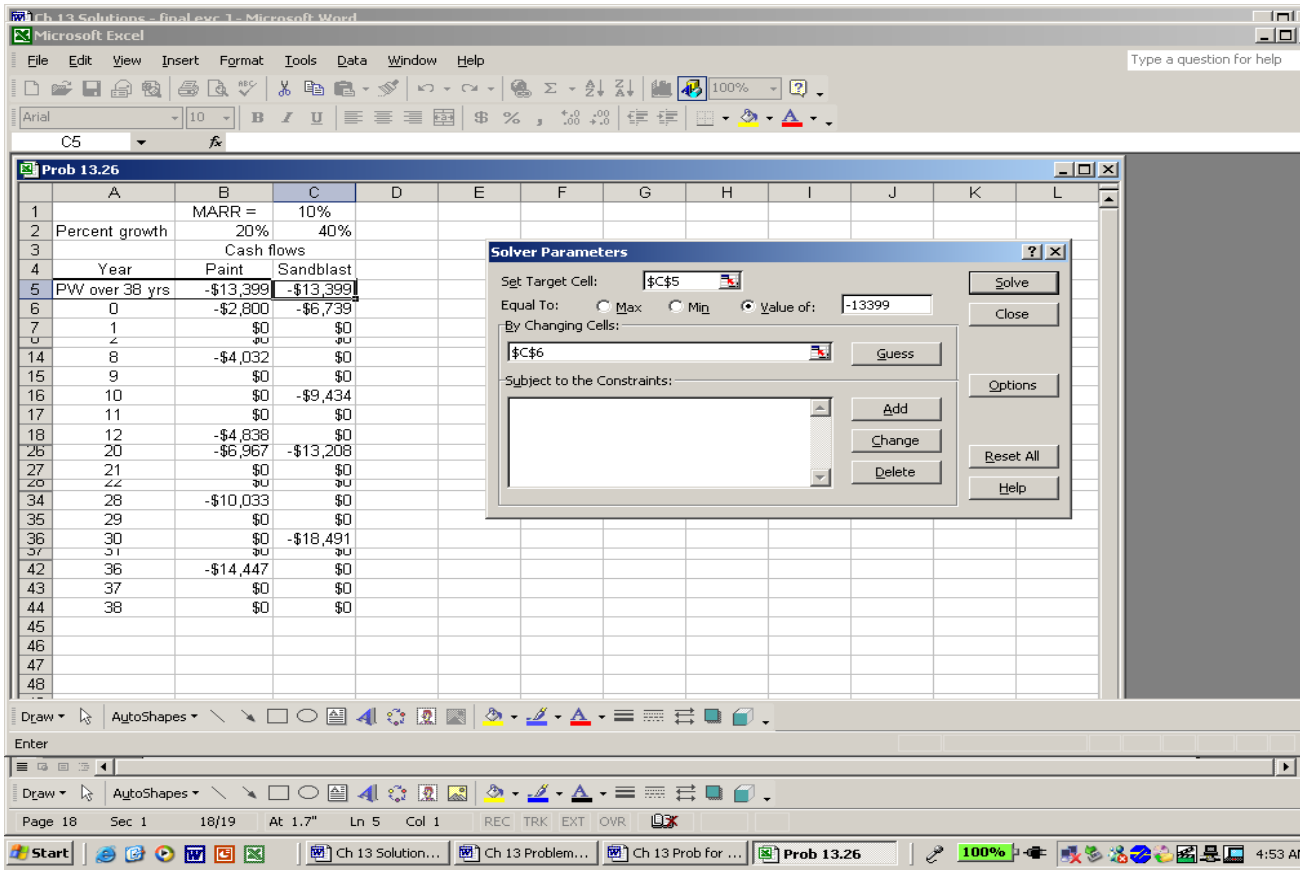
13.26 (cont)

PW of sandblasting

PW_s = -P - 1.4P(P/F,10%,10) - 1.96P(P/F,10%,20) - 2.74P(P/F,10%,30)
-P[1 + 1.4(0.3855) + 1.96(0.1486) + 2.74(0.0573)]
= -1.988P

Equate PW relations to obtain P = $6,739

(b) By computer: Enter the periodic costs. Use SOLVER to find breakeven at P = $6739.



	A	B	C
1		MARR =	10%
2	Percent growth	20%	40%
3		Cash flows	
4	Year	Paint	Sandblast
5	PW over 38 yrs	-$13,399	-$13,399
6	0	-$2,800	-$6,739
7	1	$0	$0
14	8	-$4,032	$0
15	9	$0	$0
16	10	$0	-$9,434
17	11	$0	$0
18	12	-$4,838	$0
26	20	-$6,967	-$13,208
27	21	$0	$0
34	28	-$10,033	$0
35	29	$0	$0
36	30	$0	-$18,491
42	36	-$14,447	$0
43	37	$0	$0
44	38	$0	$0

(c) Change MARR to 30% and 20%, respectively, and re-SOLVER to get:
30%: P = -$7133 20%: P = -$7546

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 14

Solutions included for problems 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, and 49

14.1 Inflated dollars are converted into constant value dollars by dividing by one plus the inflation rate per period for however many periods are involved.

14.4 Then-current dollars = $10{,}000(1 + 0.07)^{10}$
= \$19,672

14.7 CV_0 for amt in yr 1 = $13{,}000/(1 + 0.06)^{1}$
= \$12,264

CV_0 for amt in yr 2 = $13{,}000/(1 + 0.06)^{2}$
= \$11,570

CV_0 for amt in yr 3 = $13{,}000/(1 + 0.06)^{3}$
= \$10,915

14.10 (a) At a 56% increase, \$1 would increase to \$1.56. Let x = annual increase.

$1.56 = (1 + x)^5$
$1.56^{0.2} = 1 + x$
$1.093 = 1 + x$
$x = 9.3\%$ per year

(b) Amount greater than inflation rate: 9.3 – 2.5 = 6.8% per year

14.13 $i_f = 0.04 + 0.27 + (0.04)(0.27)$
= 32.08% per year

14.16 For this problem, i_f = 4% per month and i = 0.5% per month

$0.04 = 0.005 + f + (0.005)(f)$
$1.005f = 0.035$
$f = 3.48\%$ per month

14.19 Buying power = $1{,}000{,}000/(1 + 0.03)^{27}$
= \$450,189

14.22 (a) $PW_A = -31,000 – 28,000(P/A,10\%,5) + 5000(P/F,10\%,5)$
$= -31,000 – 28,000(3.7908) + 5000(0.6209)$
$= \$-134,038$

$PW_B = -48,000 – 19,000(P/A,10\%,5) + 7000(P/F,10\%,5)$
$= -48,000 – 19,000(3.7908) + 7000(0.6209)$
$= \$-115,679$
Select Machine B

(b) $i_f = 0.10 + 0.03 + (0.10)(0.03) = 13.3\%$
$PW_A = -31,000 – 28,000(P/A,13.3\%,5) + 5000(P/F,13.3\%,5)$
$= -31,000 – 28,000(3.4916) + 5000(0.5356)$
$= \$-126,087$

$PW_B = -48,000 – 19,000(P/A,13.3\%,5) + 7000(P/F,13.3\%,5)$
$= -48,000 – 19,000(3.4916) + 7000(0.5356)$
$= \$-110,591$
Select machine B

14.25 (a) New yield = 2.16 + 3.02
= 5.18% per year

(b) Interest received = 25,000(0.0518/12)
= \$107.92

14.28 $740,000 = 625,000(F/P,f,7)$
$(F/P,f,7) = 1.184$
$(1 + f)^7 = 1.184$
$f = 2.44\%$ per year

14.31 In constant-value dollars, cost will be \$40,000.

14.34 Future amount is equal to a return of i_f on its investment

$i_f = (0.10 + 0.04) + 0.03 + (0.1 + 0.04)(0.03) = 17.42\%$

Required future amt = 1,000,000(F/P,17.42%,4)
= 1,000,000(1.9009)
= \$1,900,900

Company will get more; make the investment.

14.37 $i_f = 0.15 + 0.06 + (0.15)(0.06) = 21.9\%$

AW = 183,000(A/P,21.9%,5)
= 183,000(0.34846)

= $63,768

14.40 Find amount needed at 2% inflation rate and then find A using market rate.

$F = 15{,}000(1 + 0.02)^3$
$= 15{,}000(1.06121)$
$= \$15{,}918$

$A = 15{,}918(A/F,8\%,3)$
$= 15{,}918(0.30803)$
$= \$4903$

14.43 (a) For CV dollars, use i = 12% per year

$AW_A = -150{,}000(A/P,12\%,5) - 70{,}000 + 40{,}000(A/F,12\%,5)$
$= -150{,}000(0.27741) - 70{,}000 + 40{,}000(0.15741)$
$= \$-105{,}315$

$AW_B = -1{,}025{,}000(0.12) - 5{,}000$
$= \$-128{,}000$

Select Machine A

(b) For then-current dollars, use i_f

$i_f = 0.12 + 0.07 + (0.12)(0.07) = 19.84\%$

$AW_A = -150{,}000(A/P,19.84\%,5) - 70{,}000 + 40{,}000(A/F,19.84\%,5)$
$= -150{,}000(0.3332) - 70{,}000 + 40{,}000(0.1348)$
$= \$-114{,}588$

$AW_B = -1{,}025{,}000(0.1984) - 5{,}000$
$= \$-208{,}360$

Select Machine A

14.46 Answer is (d)

14.49 Answer is (a)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 15

Solutions included for problems: 2, 4, 6, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, and 51

15.2 The bottom-up approach uses price as output and cost estimates as inputs. The design-to-cost approach is just the opposite.

15.4 Property cost: (100 X 150)(2.50) = $37,500
House cost: (50 X 46)(.75)(125) = $215,625
Furnishings: (6)(3,000) = $18,000
Total cost: $271,125

15.6 Cost = $\frac{1200}{1027.5}$ (78,000) = $91,095

15.10 (a) First find the percentage increase (p%) between 1990 and 2000.

$6221 = 4732\ (F/P,p,10)$
$1.31467 = (1+p)^{10}$
p% increase = 2.773 %/year

Predicted index value in 2002 = 6221(F/P,2.773%,2) = 6571

(b) Difference = 6571 – 6538 = 33

15.13 Find the percentage increase between 1994 and 2002.

$395.6 = 368.1(F/P,p,8)$
$1.0747 = (1+p)^{1/8}$
$(1+p) = 1.009046$
p % increase = 0.905 % per year

15.16 Index in 2005 = 1068.3(F/P,2%,6) = 1203.1

15.19 $C_2 = 13{,}000(450/250)^{0.32} = \$15{,}690$

15.22 (a) $450{,}000 = 200{,}000(60{,}000/35{,}000)^{x}$
$2.25 = 1.7143^{x}$
$x = 1.504$

(b) Since x > 1.0, there is diseconomy of scale and the larger CFM capacity is

more expensive than a linear relation would be.

15.25 (a) $C_2 = (1 \text{ million})(3)^{0.2}(1.1)$
$= (1 \text{ million})(1.246)(1.1) = \$1.37 \text{ million}$

Estimate was \$630,000 low

(b) $2 \text{ million} = (1 \text{ million})(3)^{x}(1.25)$
$1.6 = (3)^{x}$
$x = 0.428$

15.28 *ENR* construction cost index ratio is (6538/4732).
Cost -capacity exponent is 0.60.

Let C_1 = cost of 5,000 sq. m. structure in 1990

C_2 in 1990 = \$220,000 = $C_1 (10{,}000/5{,}000)^{0.60}$
$C_1 = \$145{,}145$

Update C_1 with cost index.

$C_{2002} = C_1 (6538/4732) = \$200{,}540$

15.31 $h = 1 + 0.2 + 0.5 + 0.25 = 1.95$
C_T in 1994: 1.75 (1.95) = \$3.41 million

Update with the cost index to now.
C_T now: 3.41 (3713/2509) = 3.41(1.48) = \$5.05 million

15.34 Indirect cost rate for 1 = $\frac{50{,}000}{600}$ = \$ 83.33 per hour
Indirect cost rate for 2 = $\frac{100{,}000}{200}$ = \$500.00 per hour
Indirect cost rate for 3 = $\frac{150{,}000}{800}$ = \$187.50 per hour
Indirect cost rate for 4 = $\frac{200{,}000}{1{,}200}$ = \$166.67 per hour

15.37 Housing: DLH is basis; rate is \$16.35
Actual charge = 16.35(480) = \$7,848

Subassemblies: DLH is basis; rate is \$16.35
Actual charge = 16.35(1,000) = \$16,350

Final assembly: DLC is basis; rate is \$0.23
Actual charge = 0.23 (12,460) = \$2,866

15.40 DLC average rate = (1.25 + 5.75 + 3.45) /3 = $3.483 per DLC $

Department 1: 3.483(20,000) = $ 69,660
Department 2: 3.483(35,000) = 121,905

Total actual charges: $1,068,584

Allocation variance = 800,000 – 1,068,584 = $-268,584

15.43 As the DL hours component decreases, the denominator in Eq. [15.7], basis level, will decrease. Thus, the rate for a department using automation to replace direct labor hours will increase in the computation

15.46 DLH rate = $400,00/51,300 = $7.80 per hour

Old cycle time rate = $400,000/97.3 = $4,111 per second

New cycle time rate = $400,000/45.7 = $8,752.74 per second

Actual charges = (rate)(basis level)

Line	10	11	12
DLH basis	$156,000	99,060	145,080
Old cycle time	53,443	229,394	117,164
New cycle time	34,136	148,797	217,068

The actual charge patterns are significantly different for all 3 bases.

15.49 $89,750 = 75,000(I_2/1027)$
$I_2 = 1229$
Answer is (a)

15.51 $Cost_{now} = 15,000(1164/1092)\ (2)^{0.65} = \$25,089$
Answer is (b)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 16

Solutions included for problems: 2, 4, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, and 43

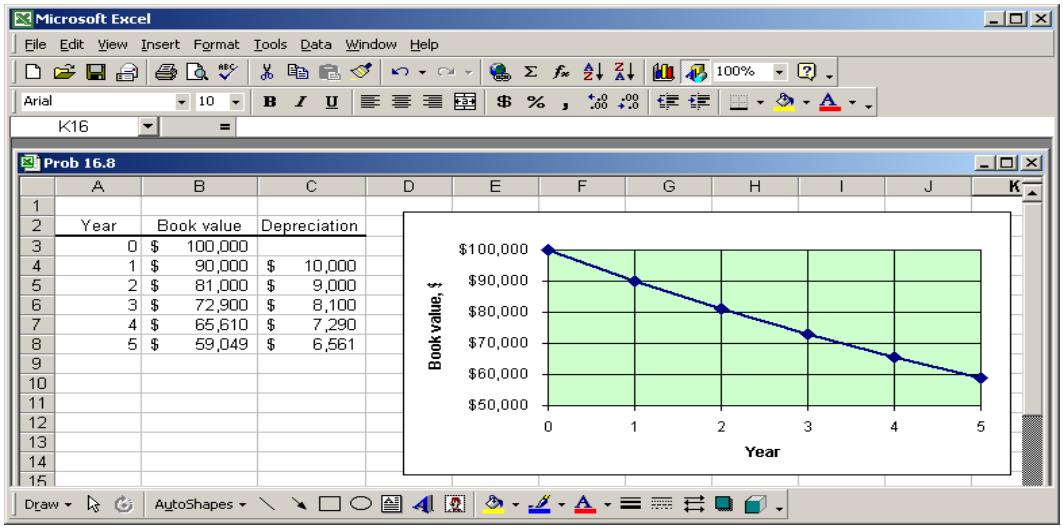
16.2 Book depreciation is used on internal financial records to reflect current capital investment in the asset. Tax depreciation is used to determine the annual tax-deductible amount. They are not necessarily the same amount.

16.4 Asset depreciation is a deductible amount in computing income taxes for a corporation, so the taxes will be reduced. Thus PW or AW may become positive when the taxes due are lower.

16.8

		Part (a)	Part (b)
Year	Book value	Annual depreciation	Depreciation rate
0	$100,000	0	-
1	90,000	$10,000	10 %
2	81,000	9000	9
3	72,900	8100	8.1
4	65,610	7290	7.3
5	59,049	6561	6.56

(c) Book value = $59,049 and market value = $24,000.
(d) Plot year versus book value in dollars for the table above



16.11 (a) $D_t = (12{,}000 - 2000)/8 = \$1250$

(b) $BV_3 = 12{,}000 - 3(1250) = \$8250$

(c) $d = 1/n = 1/8 = 0.125$

16.14 (a) B = \$50,000, n = 4, S = 0, d = 0.25

Year	Depreciation	Accumulated depreciation	Book value
0	-	-	\$50,000
1	\$12,500	\$12,500	37,500
2	12,500	25,000	5,000
3	12,500	37,500	12,500
4	12,500	50,000	0

(b) S = \$16,000; d = 0.25; (B - S) = \$34,000

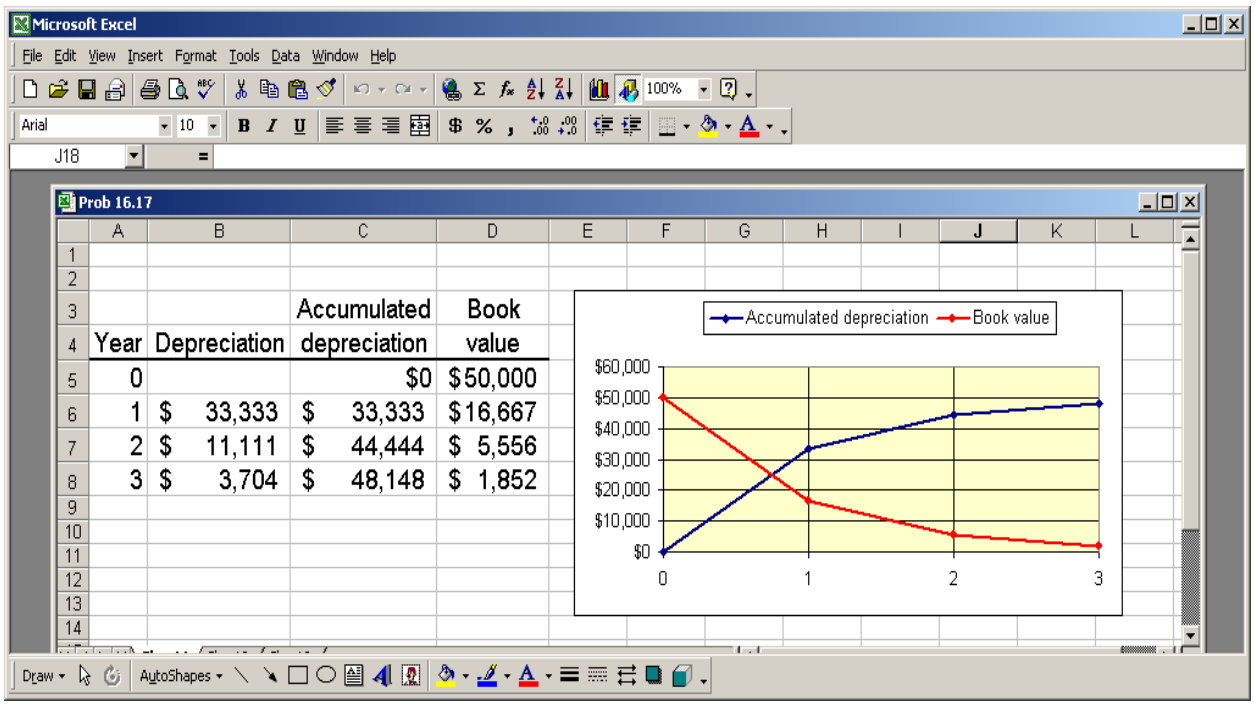
Year	Depreciation	Accumulated depreciation	Book value
0	-	-	\$50,000
1	\$8,500	\$ 8,500	41,500
2	8,500	17,000	33,000
3	8,500	25,500	24,500
4	8,500	34,000	16,000

16.17 (a) B = $50,000, n = 3, d = 0.6667 for DDB

Annual depreciation = 0.6667X(BV of previous year)

Year	Depreciation	Accumulated depreciation	Book value
0	-	-	$50,000
1	$33,335	$33,335	16,667
2	11,112	44,447	5,555
3	3,704	48,151	1,851

(b) Use the function =DDB(50000,0,3,t,2) for annual DDB depreciation.



Year	Depreciation	Accumulated depreciation	Book value
0		$0	$50,000
1	$ 33,333	$ 33,333	$16,667
2	$ 11,111	$ 44,444	$ 5,556
3	$ 3,704	$ 48,148	$ 1,852

16.20 SL: $d_t = 0.20$ of B = \$25,000 $BV_t = 25{,}000 - t(5{,}000)$

Fixed rate: DB with d = 0.25 $BV_t = 25{,}000(0.75)^t$

DDB: d = 2/5 = 0.40 $BV_t = 25{,}000(0.60)^t$

		Declining balance methods	
Year	SL	125% SL	200% SL
d	0.20	0.25	0.40
0	\$25,000	\$25,000	\$25,000
1	20,000	18,750	15,000
2	15,000	14,062	9,000
3	10,000	10,547	5,400
4	5,000	7,910	3,240
5	0	5,933	1,944

16.23 (a) d = 1.5/12 = 0.125

$D_1 = 0.125(175{,}000)(0.875)^{1-1} = \$21{,}875$
$BV_1 = 175{,}000(0.875)^1 = \$153{,}125$

$D_{12} = \$5{,}035$ $BV_{12} = \$35{,}248$

(b) The 150% DB salvage value of \$35,248 is larger than S = \$32,000.

(c) =DDB(175000,32000,12,t,1.5) for t = 1, 2, …, 12

16.26 B = \$500,000; S = \$100,000; n = 10 years

SL: d = 1/n = 1/10 $D_1 = (B\text{-}S)/n = (500{,}000 - 100{,}000)/10 = \$40{,}000$
DDB: d = 2/10 = 0.20 $D_1 = dB = 0.20(500{,}000) = \$100{,}000$
150% DB: d = 1.5/10 = 0.15 $D_1 = dB = 0.15(500{,}000) = \$75{,}000$
MACRS: d = 0.10 $D_1 = 0.10(500{,}000) = \$50{,}000$

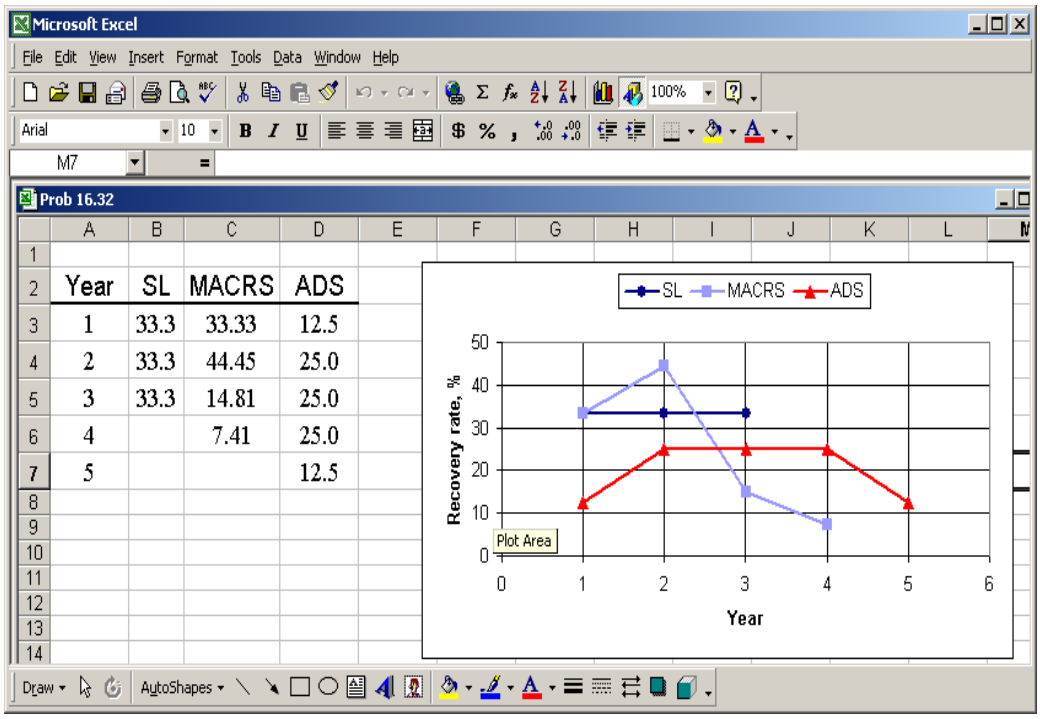
First-year tax depreciation amounts vary considerably from \$40,000 to \$100,000.

16.29 Classical SL, n = 5
$D_t = 450{,}000/5 = \$90{,}000$
$BV_3 = 450{,}000 - 3(90{,}000) = \$180{,}000$

16.29 (cont) MACRS, after 3 years for n = 5 sum the rates in Table 16.2.
$\Sigma D_t = 450{,}000(0.712) = \$320{,}400$
$BV_3 = \$450{,}000\text{-}320{,}400 = \$129{,}600$

The difference is $50,400 that is not removed by classical SL.

16.32



16.35 Percentage depletion for copper is 15% of gross income, not to exceed 50% of taxable income. Use GI = (tons)($/pound)(2000 pounds/ton).

Year	Gross income	% Depl @ 15%	50% of TI	Allowed depletion
1	$3,200,000	$480,000	$750,000	$480,000
2	7,020,000	1,053,000	1,000,000	1,000,000
3	2,990,000	448,500	500,000	448,500

16.38 Depreciation factor is 17.49%. D = 35,000(0.1749) = $6122. Answer is (d)

16.41 For SL method, BV at end of asset's life MUST equal salvage value of $10,000. Answer is (c)

16.43 Straight line rate is always used as the reference. So, answer is (a)

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 17

Solutions included for all or part of problems: 4, 6, 9, 12, 15, 18, 21, 24, 27, 29, 33, 36, 39, 42, 45, 48, 51, 54, 57, and 60

17.4 (a) Company 1

TI = (1,500,000 + 31,000) – 754,000 – 148,000 = $629,000

Taxes = 113,900 + 0.34(629,000 – 335,000) = $213,860

Company 2

TI = $236,000

Taxes = $75,290

(b) Co. 1: 213,860/1.5 million = 14.26%

Co. 2: 75,290/820,000 = 9.2%

(c) Company 1

Taxes = (TI)(T_e) = 629,000(0.34) = $213,860

% error with graduated tax = 0%

Company 2

Taxes = 236,000(0.34) = $80,240

% error = + 6.6%

17.6 T_e = 0.076 + (1 – 0.076)(0.34) = 0.390

TI = $2.4 million

Taxes = 2,400,000(0.390) = $936,000

17.9 (a) GI = 98,000 + 7500 = $105,500

TI = 105,500 – 10,500 = $95,000

Taxes = 0.10(7000) + 0.15(21,400) + 0.25(40,400) + 0.28(26,200)

= $21,346

(b) 21,346/98,000 = 21.8%

(c) Reduced taxes = 0.9(21,346) = $19,211

$19,211 = 0.10(7000) + 0.15(21,400) + 0.25(40,400) + 0.28(TI – 26,200)

= 700 + 3210 + 10,100 + 0.28(x – 68,800)

= 14,010 + 0.28(x – 68,800)

0.28x = 24,465

x = $87,375

Let y = new total of exemptions and deductions

TI = 87,375 = 105,500 – y
y = $18,125

Total must increase from $10,500 to $18,125, which is a 73% increase.

17.12 Depreciation is used to find TI. Depreciation is not a true cash flow, and as such is not a direct reduction when determining either CFBT or CFAT.

17.15 CFBT = CFAT + taxes
= [CFAT – D(T_e)]/(1 – T_e)

T_e = 0.045 + 0.955(0.35) = 0.37925

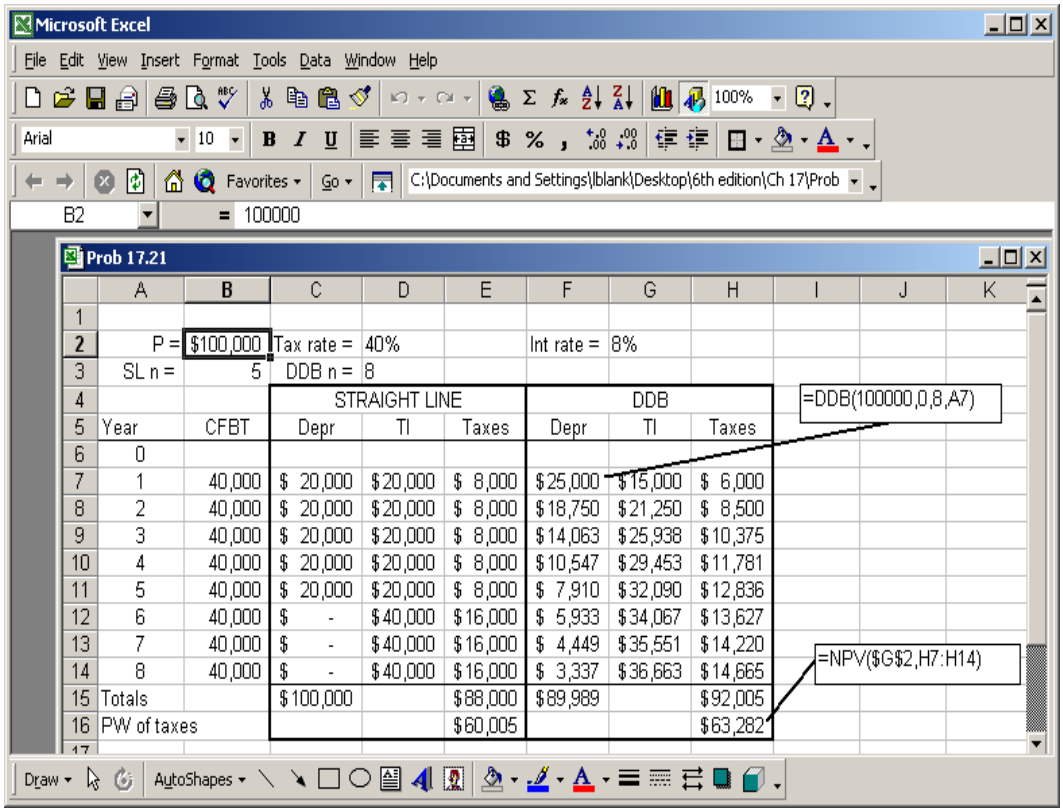
CFBT = [2,000,000 – (1,000,000)(0.37925)]/(1 – 0.37925)
= $2,610,955

17.18 (a) BV_2 = 80,000 – 16,000 – 25,600 = $38,400

(b)

Year	(GI – E)	P or S	D	TI	Taxes	CFAT
0	-	–80,000	-	-	-	-$80,000
1	50,000		16,000	34,000	12,920	37,080
2	50,000	38,400	25,600	24,400	9,272	79,128

17.21 Here Taxes = (CFBT – depr)(tax rate). Select the SL method with n = 5 years.



	A	B	C	D	E	F	G	H	I	J	K
1											
2	P =	$100,000	Tax rate =	40%		Int rate =	8%				
3	SL n =	5	DDB n =	8							
4			STRAIGHT LINE			DDB					
5	Year	CFBT	Depr	TI	Taxes	Depr	TI	Taxes			
6	0										
7	1	40,000	$ 20,000	$20,000	$ 8,000	$25,000	$15,000	$ 6,000			
8	2	40,000	$ 20,000	$20,000	$ 8,000	$18,750	$21,250	$ 8,500			
9	3	40,000	$ 20,000	$20,000	$ 8,000	$14,063	$25,938	$10,375			
10	4	40,000	$ 20,000	$20,000	$ 8,000	$10,547	$29,453	$11,781			
11	5	40,000	$ 20,000	$20,000	$ 8,000	$ 7,910	$32,090	$12,836			
12	6	40,000	$ -	$40,000	$16,000	$ 5,933	$34,067	$13,627			
13	7	40,000	$ -	$40,000	$16,000	$ 4,449	$35,551	$14,220			
14	8	40,000	$ -	$40,000	$16,000	$ 3,337	$36,663	$14,665			
15	Totals		$100,000		$88,000	$89,989		$92,005			
16	PW of taxes				$60,005			$63,282			

17.24 (a)

$$PW_{TS} = \sum_{t=1}^{t=n} (\text{tax savings in year t})(P/F,i,t)$$

Select the method that maximizes PW_{TS}.

(b) $TS_t = D_t(0.42)$. $PW_{TS} = \$27{,}963$

Year,t	d	Depr	TS
1	0.3333	$26,664	$11,199
2	0.4445	35,560	14,935
3	0.1481	11,848	4,976
4	0.0741	5,928	2,490

17.27 (a) CL = 5000 – 500 = $4500

TI = $–4500

Tax savings = 0.40(–4500) = $–1800

(b) CG = $10,000

DR = 0.2(100,000) = $20,000

TI = CG + DR = $30,000

Taxes = 30,000(0.4) = $12,000

17.29 (a) $BV_2 = 40{,}000 - 0.52(40{,}000) = \$19{,}200$

$DR = 21{,}000 - 19{,}200 = \$1800$

$TI = GI - E - D + DR = \$6{,}000$

$Taxes = 6{,}000(0.35) = \$2100$

(b) $CFAT = 20{,}000 - 3000 + 21{,}000 - 2100$

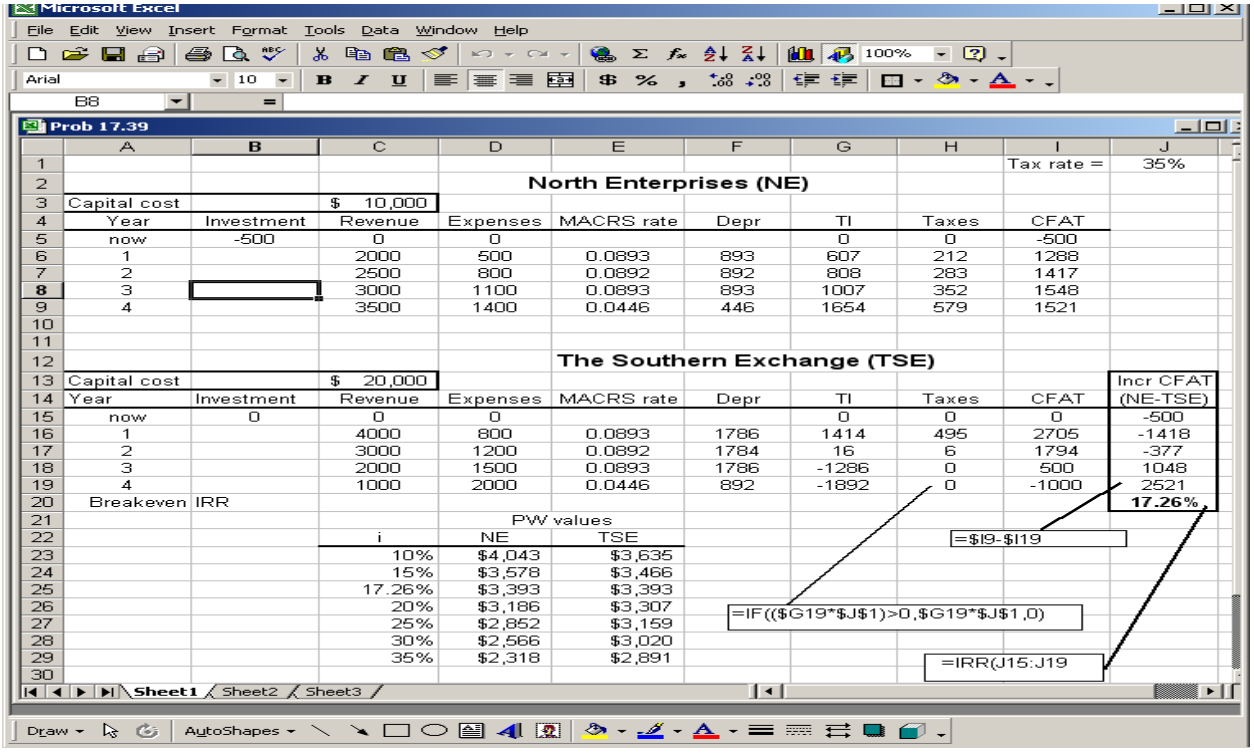
$= \$35{,}900$

17.33 In brief, net all short term, then all long term gains and losses. Finally, net the gains and losses to determine what is reported on the return and how it is taxed.

17.36 $0.08 = 0.12(1\text{-tax rate})$

Tax rate = 0.333

17.39 Since MARR = 25% exceeds the incremental i* of 17.26%, the incremental investment is not justified. Sell NE now, retain TSE for the 4 years and then dispose of it.



17.42 (a) $PW_A = -15{,}000 - 3000(P/A,14\%,10) + 3000(P/F,14\%,10)$

$= \$-29{,}839$

$PW_B = -22{,}000 - 1500(P/A,14\%,10) + 5000(P/F,14\%,10)$

$= \$-28{,}476$

Select B with a slightly smaller PW value.

(b) Machine A

Annual depreciation = (15,000 – 3,000)/10 = $1200
Tax savings = 4200(0.5) = $2100
CFAT = –3000 + 2100 = $–900

PW_A = –15,000 – 900(P/A,7%,10) + 3000(P/F,7%,10)
= $–19,796

Machine B

Annual depreciation = $1700
Tax savings = $1600
CFAT = –1500 + 1600 = $100

PW_B = –22,000 + 100(P/A,7%,10) + 5000(P/F,7%,10)
= $–18,756

Select machine B

(c) Machine A

Year	P or S	AOC	Depr	Tax savings	CFAT
0	$–15,000	-	-	-	$–15,000
1		$3000	$3000	$3000	0
2		3000	4800	3900	900
3		3000	2880	2940	-60
4		3000	1728	2364	-636
5		3000	1728	2364	-636
6		3000	864	1932	-1068
7		3000	0	1500	-1500
8		3000	0	1500	-1500
9		3000	0	1500	-1500
10		3000	0	1500	-1500
10	3000	-	-	–1500	1500

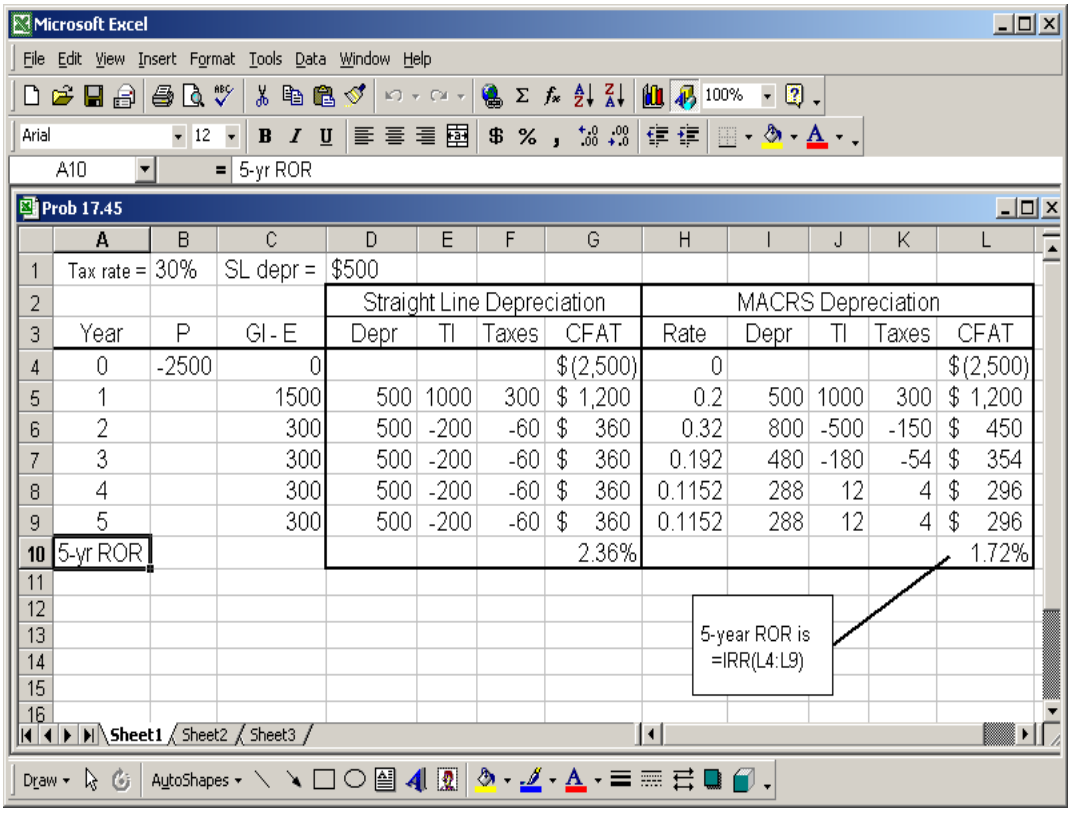
17.42 (cont) Machine B

Year	P or S	AOC	Depr	Tax savings	CFAT
0	$–22,000	-	-	-	$–22,000
1		$1500	$4400	$2950	1450
2		1500	7040	4270	2770
3		1500	4224	2862	1362
4		1500	2534	2017	517
5		1500	2534	2017	517
6		1500	1268	1384	–116

7		1500	0	750	–750
8		1500	0	750	–750
9		1500	0	750	–750
10		1500	0	750	–750
10	5000	-	-	–2500	2500

PW_A = $–18,536. PW_B = $–16,850. Select machine B, as above.

17.45 (b–1 and 2)

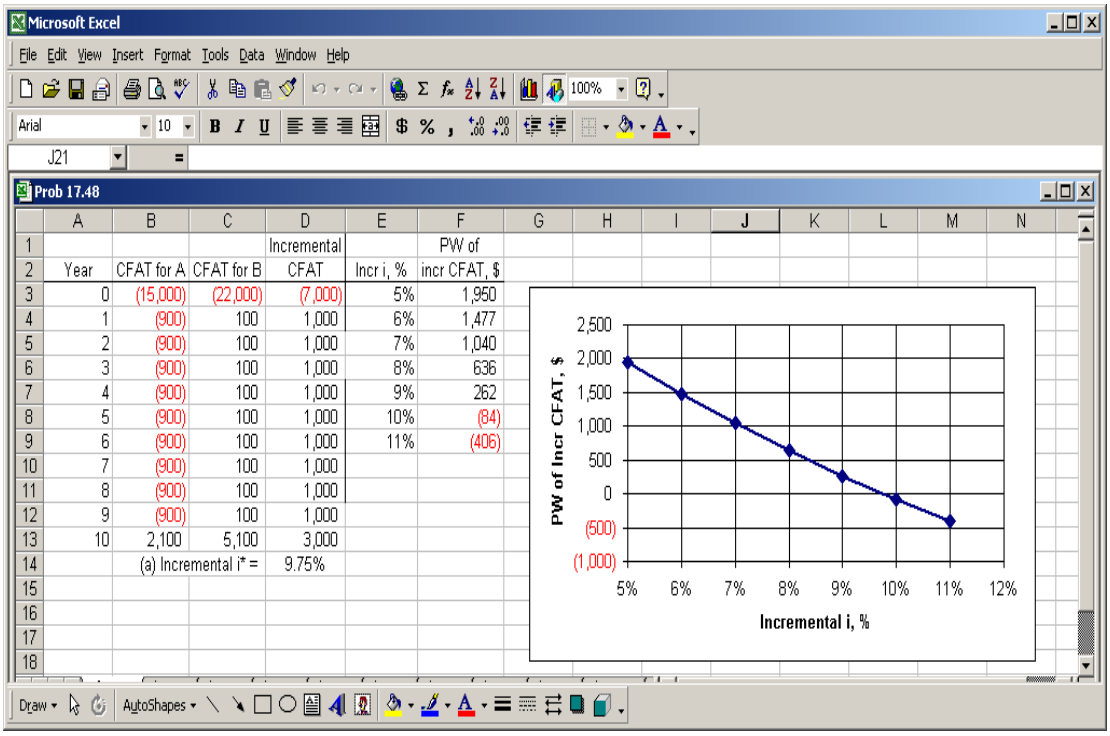


	A	B	C	D	E	F	G	H	I	J	K	L
1	Tax rate =	30%	SL depr =	$500								
2				Straight Line Depreciation				MACRS Depreciation				
3	Year	P	GI - E	Depr	TI	Taxes	CFAT	Rate	Depr	TI	Taxes	CFAT
4	0	-2500	0				$(2,500)	0				$(2,500)
5	1		1500	500	1000	300	$ 1,200	0.2	500	1000	300	$ 1,200
6	2		300	500	-200	-60	$ 360	0.32	800	-500	-150	$ 450
7	3		300	500	-200	-60	$ 360	0.192	480	-180	-54	$ 354
8	4		300	500	-200	-60	$ 360	0.1152	288	12	4	$ 296
9	5		300	500	-200	-60	$ 360	0.1152	288	12	4	$ 296
10	5-yr ROR						2.36%					1.72%

17.48 (a) From Problem 17.42(b) for years 1 through 10.

$CFAT_A$ = $–900 $CFAT_B$ = $+100

Use a spreadsheet to find the incremental ROR and to determine the PW of incremental CFAT versus incremental i values. If MARR < 9.75%, select B, otherwise select A.



	A	B	C	D	E	F
1				Incremental		PW of
2	Year	CFAT for A	CFAT for B	CFAT	Incr i, %	incr CFAT, $
3	0	(15,000)	(22,000)	(7,000)	5%	1,950
4	1	(900)	100	1,000	6%	1,477
5	2	(900)	100	1,000	7%	1,040
6	3	(900)	100	1,000	8%	636
7	4	(900)	100	1,000	9%	262
8	5	(900)	100	1,000	10%	(84)
9	6	(900)	100	1,000	11%	(406)
10	7	(900)	100	1,000		
11	8	(900)	100	1,000		
12	9	(900)	100	1,000		
13	10	2,100	5,100	3,000		
14		(a) Incremental i* =		9.75%		

(b) Use the PW vs. incremental i plot to select between A and B.

MARR	Select
5%	B
9	B
10	A
12	A

17.51 Defender

Annual SL depreciation = 450,000 /12 = $37,500

Annual tax savings = (37,500 + 160,000)(0.32) = $63,200

AW_D = -50,000(A/P,10%,5) – 160,000 + 63,200

= $–109,990

Challenger

Book value of D = 450,000 – 7(37,500) = $187,500

CL from sale of D = BV_7 – Market value = $137,500

Tax savings from CL, year 0 = 137,500(0.32) = $44,000

Challenger annual SL depreciation = $65,000

Annual tax saving = (65,000 +150,000)(0.32) = $68,800

AW_C = $-184,827

Select the defender. Decision was incorrect.

17.54 Succession options

Option	Defender	Challenger
1	2 years	1 year
2	1	2
3	0	3

Defender

AW_{D1} = \$300,000 AW_{D2} = \$240,000

Challenger

No tax effect if defender is cancelled. Calculate CFAT for 1, 2, and 3 years of ownership. Tax rate is 35%.

Year 1: TI = –120,000 – 266,640 + 66,640 = \$–320,000
Year 2: TI = –120,000 – 355,600 + 222,240 = \$–253,360
Year 3: TI = –120,000 – 118,480 + 140,720 = \$–97,760

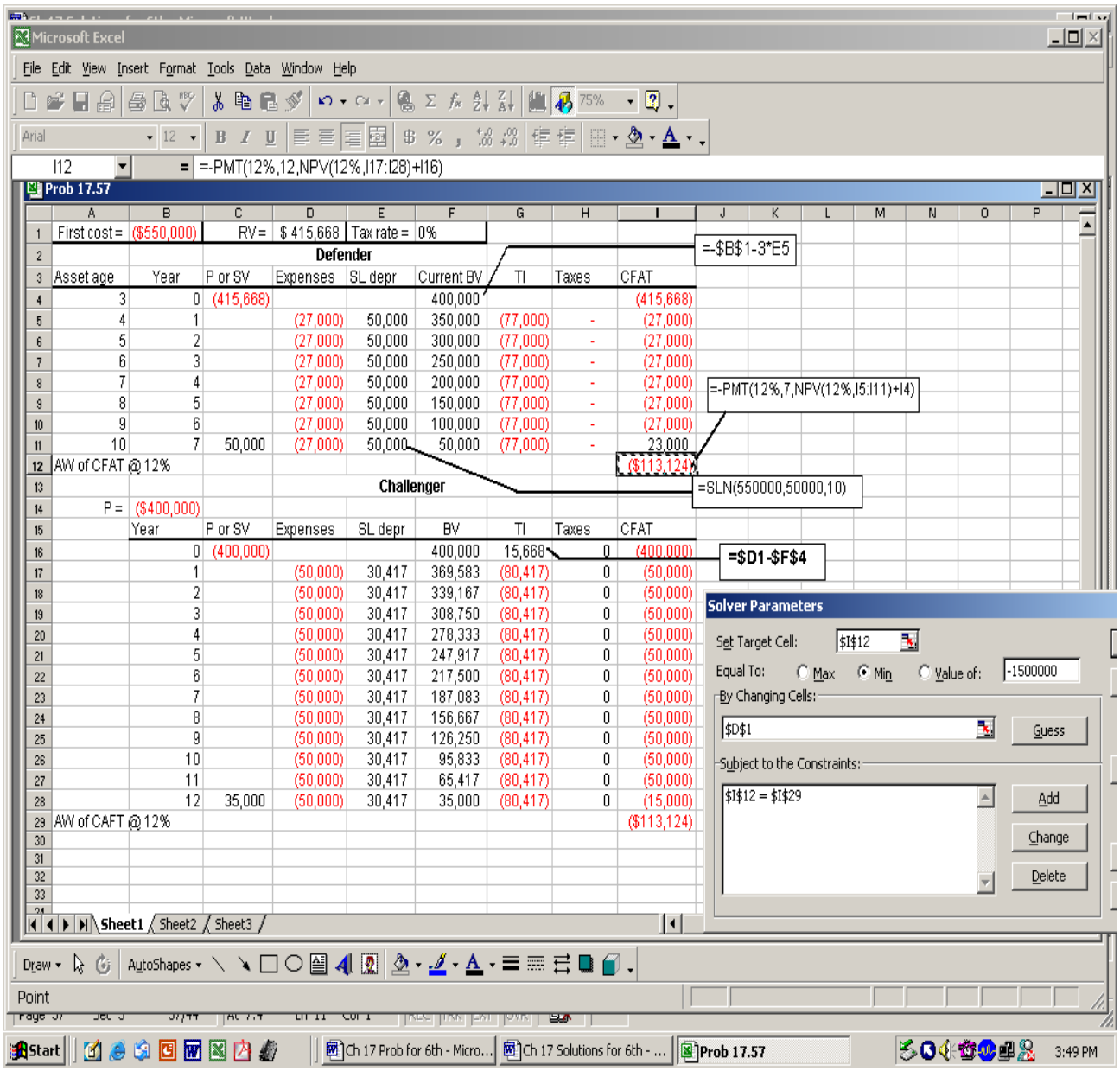
Year 1: CFAT = –120,000 + 600,000 – (–112,000) = \$592,000
Year 2: CFAT = -120,000 + 400,000 – (-88,676) = \$368,676
Year 3: CFAT = -120,000 + 200,000 – (-34,216) = \$114,216

AW_{C1} = \$– 288,000
AW_{C2} = \$+24,696
AW_{C3} = \$+51,740

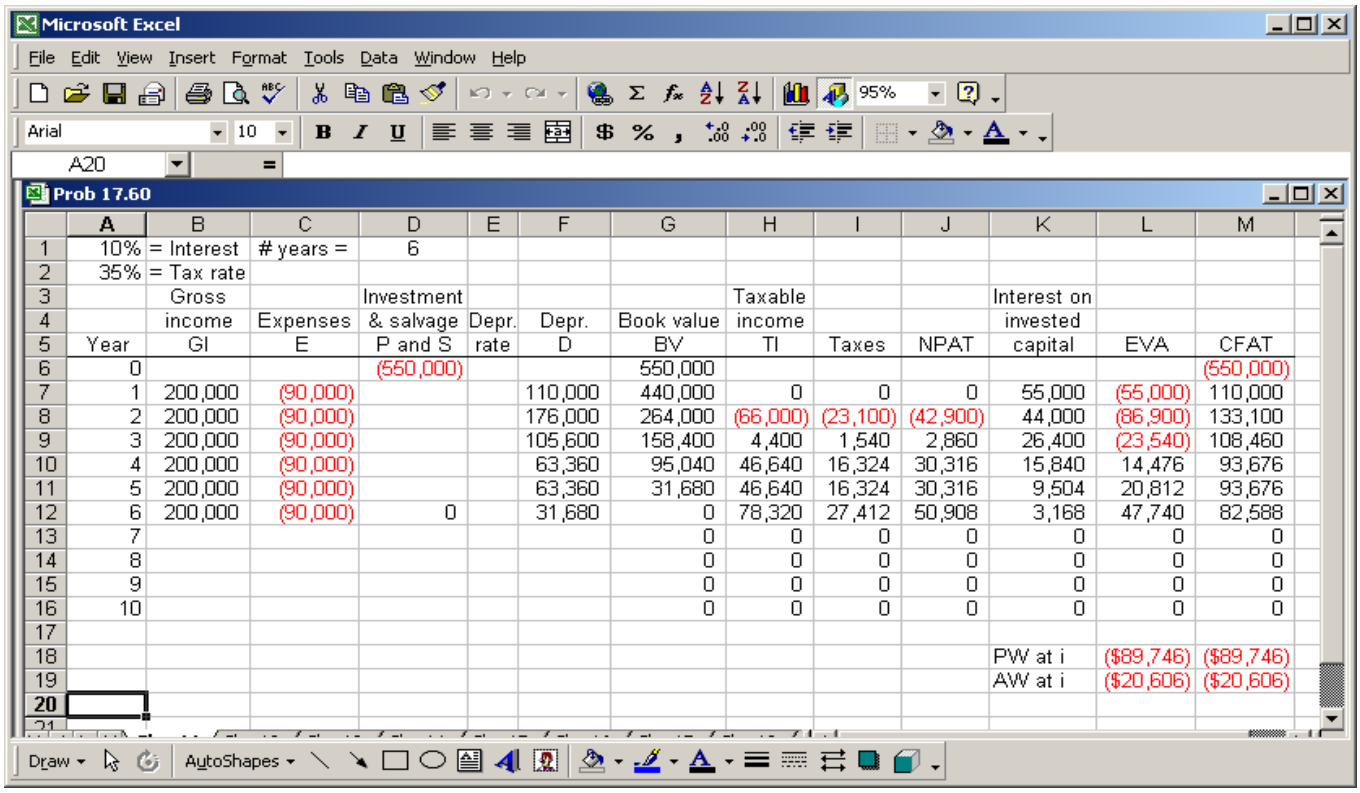
Selection of best option: Replace now with the challenger.

	Year			
Option	1	2	3	AW
1	\$–240,000	\$–240,000	\$–288,000	\$–254,493
2	–300,000	24,696	24,696	– 94,000
3	51,740	51,740	51,740	+ 51,740

17.57 (a) Before taxes: Let RV = 0 to start and establish CFAT column and AW of CFAT series. If tax rate is 0%, RV = \$415,668.



17.60 (a) Take TI, taxes and D from Example 17.3. Use i = 0.10 and T_e = 0.35.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	10%	= Interest	# years =	6									
2	35%	= Tax rate											
3		Gross		Investment				Taxable			Interest on		
4		income	Expenses	& salvage	Depr.	Depr.	Book value	income			invested		
5	Year	GI	E	P and S	rate	D	BV	TI	Taxes	NPAT	capital	EVA	CFAT
6	0			(550,000)			550,000						(550,000)
7	1	200,000	(90,000)			110,000	440,000	0	0	0	55,000	(55,000)	110,000
8	2	200,000	(90,000)			176,000	264,000	(66,000)	(23,100)	(42,900)	44,000	(86,900)	133,100
9	3	200,000	(90,000)			105,600	158,400	4,400	1,540	2,860	26,400	(23,540)	108,460
10	4	200,000	(90,000)			63,360	95,040	46,640	16,324	30,316	15,840	14,476	93,676
11	5	200,000	(90,000)			63,360	31,680	46,640	16,324	30,316	9,504	20,812	93,676
12	6	200,000	(90,000)	0		31,680	0	78,320	27,412	50,908	3,168	47,740	82,588
13	7						0	0	0	0	0	0	0
14	8						0	0	0	0	0	0	0
15	9						0	0	0	0	0	0	0
16	10						0	0	0	0	0	0	0
17													
18											PW at i	($89,746)	($89,746)
19											AW at i	($20,606)	($20,606)
20													

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 18

Solutions included for problems: 1, 4, 7, 10, 13, 16, 19, 22, 25, 29, 31, and 34

18.1 10 tons/day: PW = – 62,000 + 1500P/F,10%,8) – 0.50(10)(200)(P/A,10%,8)
– 4(8)(200)(P/A,10%,8)
= $–100,779
20 tons/day: PW = $–140,257
30 tons/day: PW = $–213,878

18.4 PW_{Build} = –80,000 – 70(1000) + 120,000(P/F,20%,3)
= $-80,556

PW_{Lease} = –(2.5)(12)(1000) – (2.50)(12)(1000)(P/A,20%,2)
= $–75,834
Lease the space.

New construction cost = 70(0.90) = $63 and lease at $2.75

PW_{Build} = $–73,556
PW_{Lease} = $–83,417

Select build. The decision is sensitive.

18.7 (a) Breakeven number of vacation days per year is x.

AW_{cabin} = –130,000(A/P,10%,10) + 145,000(A/F,10%,10) – 1500
+ 150x – (50/30) (1.20)x

$AW_{trailer}$ = –75,000(A/P,10%,10) + 20,000(A/F,10%,10) – 1,750
+ 125x – [300/30(0.6)](1.20)x

$AW_{cabin} = AW_{trailer}$

x = 19.94 days (Use x = 20 days per year)

(b) Determine AW for 12, 16, 20, 24, and 28 days.

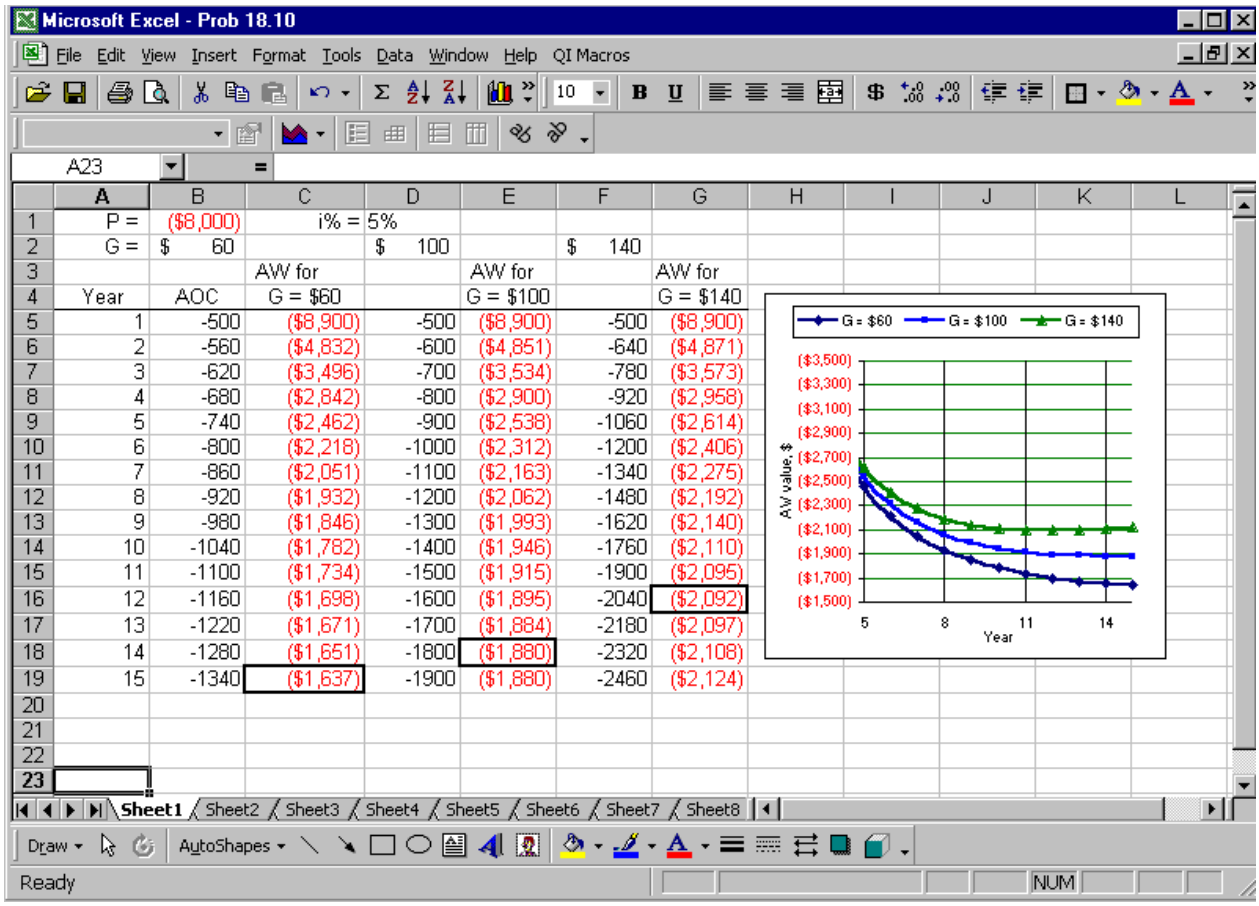
AW_{cabin} = –13,558.75 + 148x $AW_{trailer}$= –12,701.25 + 105x

Days, x	AW_{cabin}	$AW_{trailer}$	Selected
12	$-11,783	$-11,441	Trailer
16	-11,191	-11,021	Trailer

20	-10,599	-10,601	Cabin
24	-10,007	-10,181	Cabin
28	- 9415	- 9761	Cabin

Each pair of AW values are close to each other, especially for x = 20.

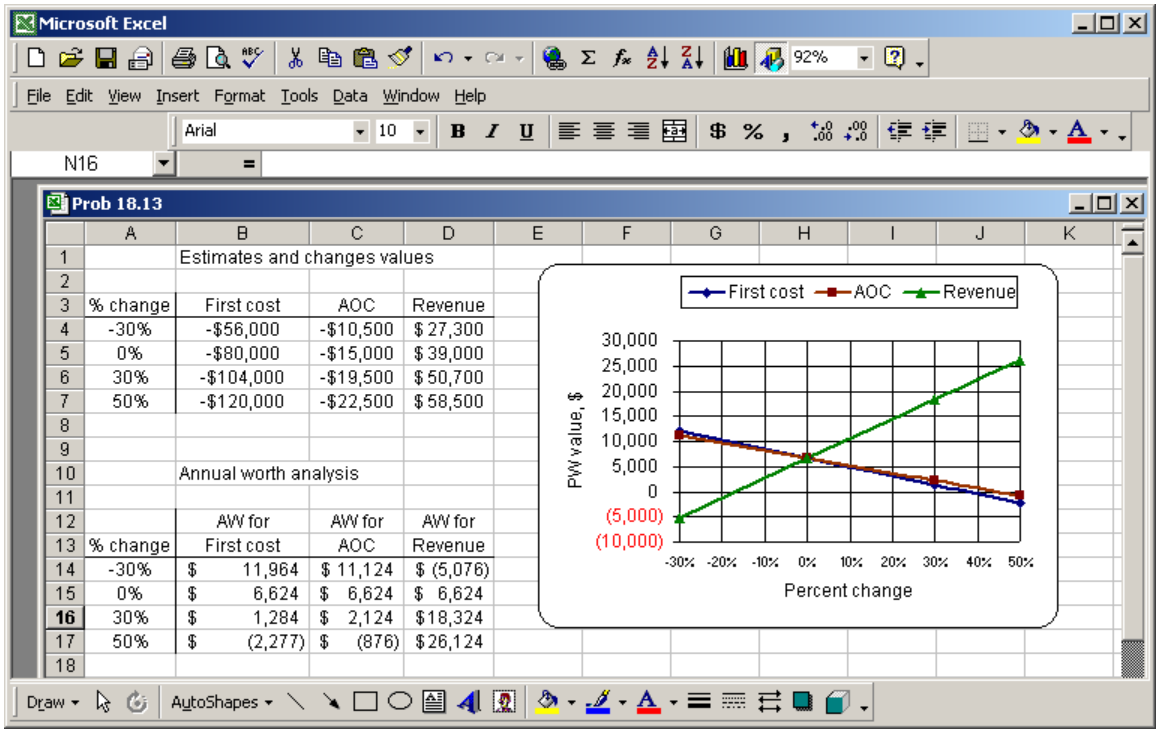
18.10 For spreadsheet analysis, use the PMT functions to obtain the AW for each n value for each G amount.



	A	B	C	D	E	F	G
1	P =	($8,000)	i% =	5%			
2	G =	$ 60		$ 100		$ 140	
3			AW for		AW for		AW for
4	Year	AOC	G = $60		G = $100		G = $140
5	1	-500	($8,900)	-500	($8,900)	-500	($8,900)
6	2	-560	($4,832)	-600	($4,851)	-640	($4,871)
7	3	-620	($3,496)	-700	($3,534)	-780	($3,573)
8	4	-680	($2,842)	-800	($2,900)	-920	($2,958)
9	5	-740	($2,462)	-900	($2,538)	-1060	($2,614)
10	6	-800	($2,218)	-1000	($2,312)	-1200	($2,406)
11	7	-860	($2,051)	-1100	($2,163)	-1340	($2,275)
12	8	-920	($1,932)	-1200	($2,062)	-1480	($2,192)
13	9	-980	($1,846)	-1300	($1,993)	-1620	($2,140)
14	10	-1040	($1,782)	-1400	($1,946)	-1760	($2,110)
15	11	-1100	($1,734)	-1500	($1,915)	-1900	($2,095)
16	12	-1160	($1,698)	-1600	($1,895)	-2040	($2,092)
17	13	-1220	($1,671)	-1700	($1,884)	-2180	($2,097)
18	14	-1280	($1,651)	-1800	($1,880)	-2320	($2,108)
19	15	-1340	($1,637)	-1900	($1,880)	-2460	($2,124)
20							
21							
22							
23							

The AW curves are quite flat; there are only a few dollars difference for the various n values around the n* value for each gradient value.

18.13 (a) First cost sensitivity: AW = –P(0.22251) + 24,425
(b) AOC sensitivity: AW = –AOC + 21,624
(c) Revenue sensitivity: AW = –32,376 + Revenue



% change	First cost	AOC	Revenue
-30%	-$56,000	-$10,500	$ 27,300
0%	-$80,000	-$15,000	$ 39,000
30%	-$104,000	-$19,500	$ 50,700
50%	-$120,000	-$22,500	$ 58,500

% change	AW for First cost	AW for AOC	AW for Revenue
-30%	$ 11,964	$ 11,124	$ (5,076)
0%	$ 6,624	$ 6,624	$ 6,624
30%	$ 1,284	$ 2,124	$18,324
50%	$ (2,277)	$ (876)	$26,124

18.16 Water/wastewater cost = (0.12 + 0.04) per 1000 liters = 0.16 per 1000 liters

Spray Method

Pessimistic - 100 liters

Water required = 10,000,000(100) = 1.0 billion
AW = –(0.16/1000)(1.00 X 10^9) = $–160,000

Most Likely - 80 liters

Water required = 10,000,000(80) = 800 million
AW = –(0.16/1000)(800,000,000) = $–128,000

Optimistic - 40 liters

Water required = 10,000,000(40) = 400 million
AW = –(0.16/1000)(400,000,000) = $–64,000

Immersion Method

AW = –10,000,000(40)(0.16/1000) – 2000(A/P,15%,10) – 100 = $–64,499

Immersion method is cheaper, unless optimistic estimate of 40 L is the actual.

18.19 (a) E(time) = (1/4)(10 + 20 + 30 + 70) = 32.5 seconds

(b) E(time) = 20 seconds

The 70 second estimate does increase the mean significantly.

18.22 E(i) = 103/20 = 5.15%

18.25 E(revenue) = $222,000

$$E(AW) = -375{,}000(A/P,12\%,10) - 25{,}000[(P/F,12\%,4) + (P/F,12\%,8)](A/P,12\%,10) - 56{,}000 + 222{,}000$$
$$= \$95{,}034$$

Construct mock mountain.

18.29 AW = annual loan payment + (damage) x P(rainfall amount or greater)
Subscript on AW indicates the rainfall amount.

$AW_{2.00}$ = $–42,174

$AW_{2.25}$ = $–35,571

$AW_{2.50}$ = $–43,261

$AW_{3.00}$ = $–54,848

$AW_{3.25}$ = $–61,392

Build a wall to protect against a rainfall of 2.25 inches with an expected AW of $–35,571.

18.31 D3: Top: E(value) = $30
Bottom: E(value) = $10
Select top at D3 for $30

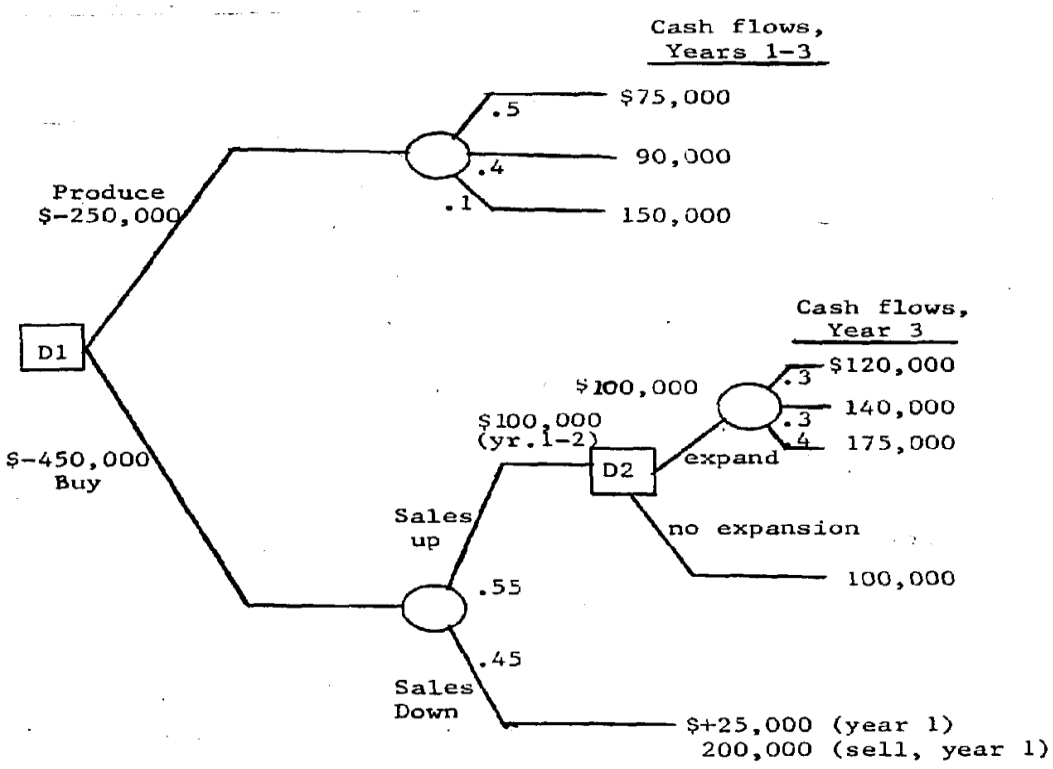
D1: Top: Value at D1 = 77-50 = $27
Bottom: 90 – 80 = $10
Select top at D1 for $27

D2: Top: E(value) = $66
Middle: E(value) = 0.5(200 – 100) = $50
Bottom: E(value) = $50

18.31 (cont) At D2, value = E(value) – investment
Top: 66 – 25 = $41
Middle: 50 – 30 = $20
Bottom: 50 – 20 = $30
Select top at D2 for $41

Conclusion: Select D2 path and choose top branch ($25 investment)

18.34 (a) Construct the decision tree.



(b) Expansion option

(PW for D2, $120,000) = $4352
(PW for D2, $140,000) = $21,744
(PW for D2, $175,000) = $52,180

E(PW) = $28,700

18.34 (cont) No expansion option

(PW for D2, $100,000 = $86,960

E(PW) = $86,960

Conclusion at D2: Select no expansion option

(c) Complete foldback to D1.

Produce option, D1

E(PW of cash flows) = $202,063

E(PW for produce) = $–47,937

Buy option, D1

At D2, E(PW) = $86,960

E(PW for buy) = cost + E(PW of sales cash flows)
= –450,000 + 0.55(PW sales up) + 0.45(PW sales down)
= –450,000 + 0.55 (228,320) + 0.45(195,660)
= $–236,377

Conclusion: Both returns are less than 15%, but the expected return is larger for produce option than buy.

(d) The return would increase on the initial investment, but would increase faster for the produce option.

SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 19

Solutions included for problems: 2, 5, 8, 11, 14, 17, and 20

19.2 Needed or assumed information to be able to calculate an expected value:

1. Treat output as discrete or continuous variable.
2. If discrete, center points on cells, e.g., 800, 1500, and 2200 units per week.
3. Probability estimates for < 1000 and /or > 2000 units per week.

19.5 (a) $P(N) = (0.5)^N$ N = 1,2,3,... is discrete

N	1	2	3	4	5	etc.
P(N)	0.5	0.25	0.125	0.0625	0.03125	
F(N)	0.5	0.75	0.875	0.9375	0.96875	

P(L) is a triangular distribution with the mode at 5.

$$f(\text{mode}) = f(M) = \frac{2}{5-2} = \frac{2}{3}$$

$$F(\text{mode}) = F(M) = \frac{5-2}{5-2} = 1$$

(b) P(N = 1, 2 or 3) = F(N ≤ 3) = 0.875

19.8 (a)

X_i	1	2	3	6	9	10
$F(X_i)$	0.2	0.4	0.6	0.7	0.9	1.0

(b) P(6 ≤ X ≤ 10) = F(10) – F(3) = 1.0 – 0.6 = 0.4
P(X = 4, 5 or 6) = F(6) – F(3) = 0.7 – 0.6 = 0.1

(c) P(X = 7 or 8) = F(8) – F(6) = 0.7 – 0.7 = 0.0

No sample values in the 50 have X = 7 or 8. A larger sample is needed to observe all values of X.

19.11 Use the steps in Section 19.3. As an illustration, assume the probabilities that are assigned by a student are:

$$P(G = g) = \begin{bmatrix} 0.30 & G=A \\ 0.40 & G=B \\ 0.20 & G=C \\ 0.10 & G=D \\ 0.00 & G=F \\ 0.00 & G=I \end{bmatrix}$$

Steps 1 and 2: The F(G) and RN assignment are:

$$F(G = g) = \begin{bmatrix} 0.30 & G=A & 00\text{-}29 \\ 0.70 & G=B & 30\text{-}69 \\ 0.90 & G=C & 70\text{-}89 \\ 1.00 & G=D & 90\text{-}99 \\ 1.00 & G=F & -- \\ 1.00 & G=I & -- \end{bmatrix}$$

RNs

Steps 3 and 4: Develop a scheme for selecting the RNs from Table 19-2. Assume you want 25 values. For example, if $RN_1 = 39$, the value of G is B. Repeat for sample of 25 grades.

Step 5: Count the number of grades A through D, calculate the probability of each as count/25, and plot the probability distribution for grades A through I. Compare these probabilities with P(G = g) above.

19.14 (a) Convert P(X) data to frequency values to determine s.

X	P(X)	XP(X)	f	X^2	fX^2
1	.2	.2	10	1	10
2	.2	.4	10	4	40
3	.2	.6	10	9	90
6	.1	.6	5	36	180
9	.2	1.8	10	81	810
10	.1	1.0	5	100	500
		4.6			1630

Sample average: Xbar = 4.6

Sample variance: $s^2 = \frac{1630}{49} - \frac{50}{49}(4.6)^2 = 11.67$

$s = 3.42$

19.14 (cont) (b) Xbar ± 1s is 4.6 ± 3.42 = 1.18 and 8.02
25 values, or 50%, are in this range.

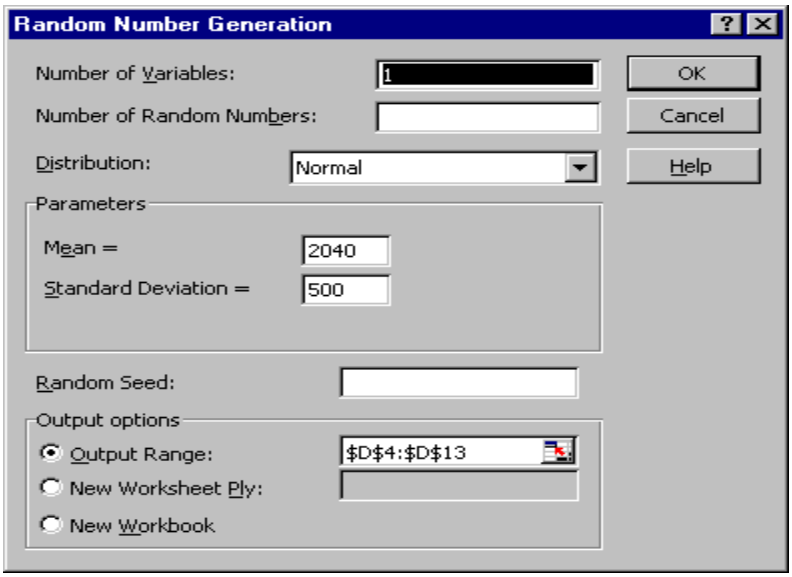
Xbar ± 2s is 4.6 ± 6.84 = –2.24 and 11.44
All 50 values, or 100%, are in this range.

19.17 $P(N) = (0.5)^N$

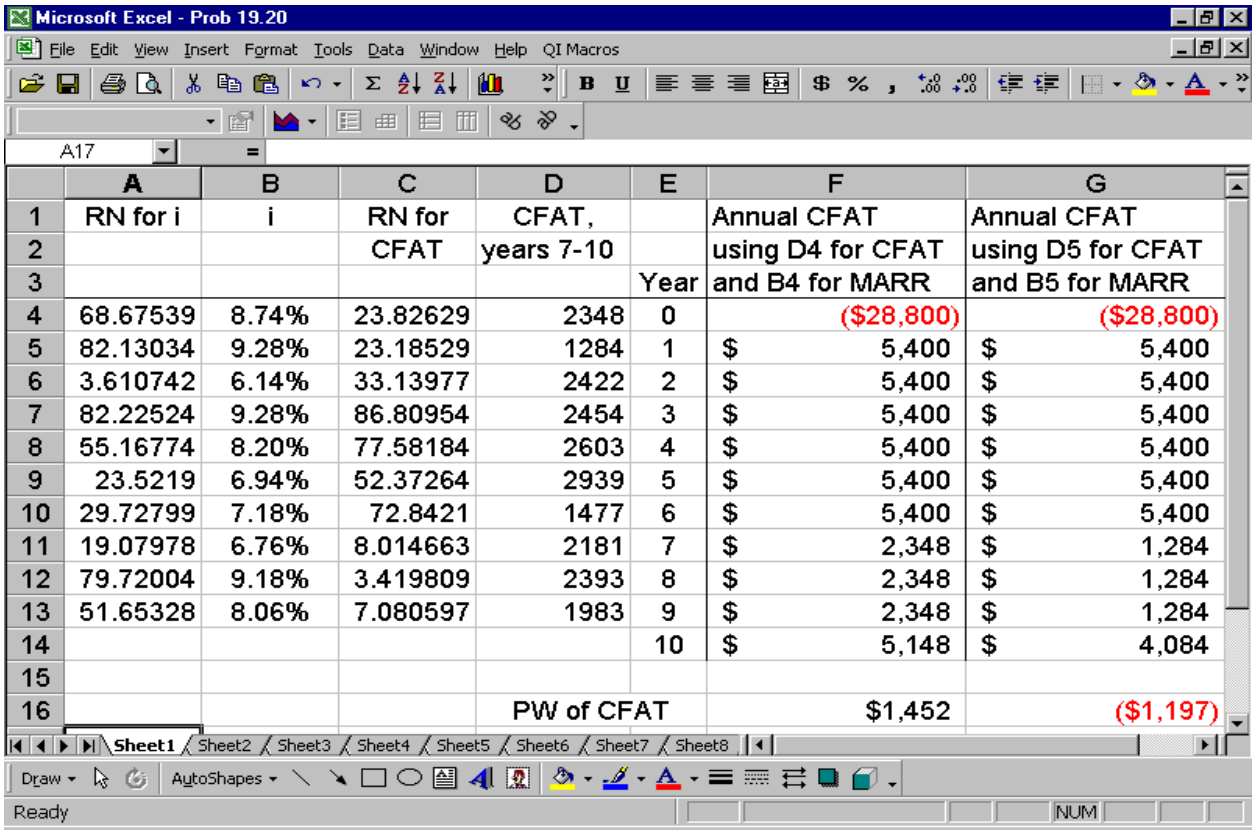
$E(N) = 1(.5) + 2(.25) + 3(.125) + 4(0.625) + 5(.03125) + 6(.015625) + 7(.0078125) + 8(.003906) + 9(.001953) + 10(.0009766) + ..$
$= 1.99+$

The limit to the series $N(0.5)^N$ is 2.0, the correct answer.

19.20 Use the spreadsheet Random Number Generator (RNG) on the tools toolbar to generate CFAT values in column D from a normal distribution with μ = \$2040 and σ = \$500. The RNG screen image is shown below. (This tool may not be available on all spreadsheets.)



19.20 (cont)



	A	B	C	D	E	F	G
1	RN for i	i	RN for	CFAT,		Annual CFAT	Annual CFAT
2			CFAT	years 7-10		using D4 for CFAT	using D5 for CFAT
3					Year	and B4 for MARR	and B5 for MARR
4	68.67539	8.74%	23.82629	2348	0	($28,800)	($28,800)
5	82.13034	9.28%	23.18529	1284	1	$ 5,400	$ 5,400
6	3.610742	6.14%	33.13977	2422	2	$ 5,400	$ 5,400
7	82.22524	9.28%	86.80954	2454	3	$ 5,400	$ 5,400
8	55.16774	8.20%	77.58184	2603	4	$ 5,400	$ 5,400
9	23.5219	6.94%	52.37264	2939	5	$ 5,400	$ 5,400
10	29.72799	7.18%	72.8421	1477	6	$ 5,400	$ 5,400
11	19.07978	6.76%	8.014663	2181	7	$ 2,348	$ 1,284
12	79.72004	9.18%	3.419809	2393	8	$ 2,348	$ 1,284
13	51.65328	8.06%	7.080597	1983	9	$ 2,348	$ 1,284
14					10	$ 5,148	$ 4,084
15							
16				PW of CFAT		$1,452	($1,197)

The decision to accept the plan uses the logic:

Conclusion: For certainty, accept the plan if PW > $0 at MARR of 7% per year.
For risk, the result depends on the preponderance of positive PW values from the simulation, and the distribution of PW obtained.